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APRIL, 1844.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Letter on Engineering. *By* Dr. Franklin.

The following letter on the improvement of the navigation of the river Schuylkill, written by Dr. Franklin, in London, in 1772, and addressed to S. Rhoads, Esq., of Philadelphia, the original of which is in the possession of a gentleman of this city, is a fine illustration of the sound, common sense, and far-seeing sagacity of that great philosopher, and is well worthy of a place in the Journal of the Institute which bears his name.

Since the days of Brindley and Smeaton, the fathers of British engineering, the improvements in hydraulic constructions, with the additional experience obtained in *slack-water navigations*, have made them, in many cases, preferable to canals, particularly for large boats, and in places where the preponderating trade is descending.

In twenty years, since the Schuylkill navigation was first opened, nearly eight millions of tons have been transported upon it; during the whole of which time it has been progressively improving, and adding more and more to the prosperity of Philadelphia.

S. W. R.

[Copy.]

London, August 22, 1772.

Dear Friend,—I think I before acknowledged your favor of February 29th; I have since received that of May 30th. I am glad my canal papers were agreeable to you. If any work of that kind is set on foot in America, I think it would be saving money to engage, by a handsome salary, an engineer from here, who has been accustomed

to such business. The many canals on foot here, under different great masters, are daily raising a number of pupils in the art, some of whom may want employ hereafter; and a single mistake through inexperience, in such important works, may cost much more than the expense of salary to an ingenious young man already well acquainted with both principles and practice. This the Irish have learnt at a dear rate, in the first attempt of their great canal, and now are endeavoring to get Smeaton to come and rectify their errors. With regard to your question, whether it is best to make the Schuylkill a part of the navigation to the back country, or whether the difficulty of that river, subject to all the inconveniences of floods, ice, &c., will not be greater than the expense of digging, locks, &c., I can only say, that here they look on the constant practicability of a navigation, allowing boats to pass and repass, at all times and seasons, without hindrance, to be a point of the greatest importance; and, therefore, they seldom, or ever, use a river where it can be avoided. Locks in rivers are subject to many more accidents than those in still-water canals; and the carrying away a few locks by freshes, or ice, not only creates a great expense, but interrupts business for a long time, till repairs are made, which may soon be destroyed again; and thus the carrying on a course of business, by such a navigation, be discouraged, as subject to frequent interruptions: the toll, too, must be higher to pay for such repairs. Rivers are ungovernable things, especially in hilly countries; canals are quiet, and very manageable: therefore, they are often carried on here by the sides of rivers, only on ground above the reach of floods, no other use being made of the rivers than to supply, occasionally, the waste of water in the canals.

I warmly wish success to every attempt for improvements of our dear country; and am, with sincere esteem,

Yours most affectionately,

B. Franklin.

S muel Rhoads, Esq.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On ascertaining, by inspection, the areas of Transverse Sections of Excavations and Embankments, with transverse ground slopes.

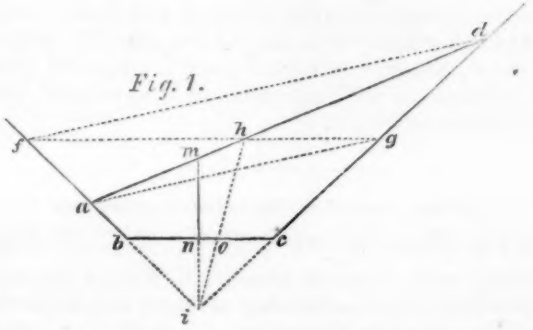
By John C. Trautwine, C. E., & Arch.

The following method of ascertaining, *by inspection*, the areas of transverse sections of excavations and embankments, *with transverse ground slopes*, by means of a table of level cuttings, aided by diagrams, may sometimes be found convenient; it was devised by myself:—

Let *a b c d*, fig. 1, represent the transverse section of an excavation, or, by inversion, of an embankment, with a transverse ground slope, *a d*; and let *m n*, represent the depth of cutting, or filling, as generally taken by the level, at the centre *(n)* of the base, *b c*. As a preparatory step, lay a ruler parallel to *b c*, so as to make the triangle, *h a f*, as nearly as can be judged *by the eye*, equal to the triangle *h g d*,

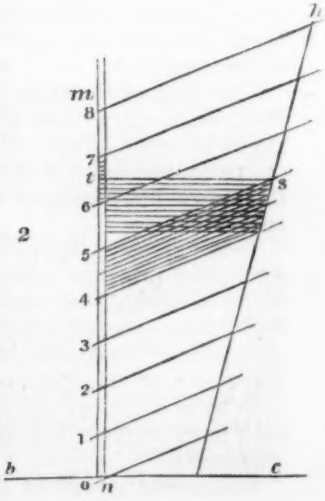
and mark the points *f* and *g*. Then, to ascertain whether the two triangles be *really* equal to each other, lay a parallel ruler from *a* to *g*, and if, on transferring it to *f* and *d*, the line *a g*, is found to be parallel to the line *f d*, the two triangles *h a f*, and *h g d*, are equal to each other, because they both stand up on the same base *a g*, and are between the same parallels *a g*, and *f d*. But if the lines *a g*, and *f d*, are found not to be parallel to each other, the trial must be repeated until they become so. A few seconds will generally suffice for this process.

Fig. 1.



Having found the proper line, *f g*, draw a straight line from the point *h*, where it intersects the ground slope *a d*, to *i*, the point at which the side slopes meet, if continued. Then the portion *n o h m*, of the triangle *m h i*, prepared, as shown in fig. 2, will suffice for ascertaining, by inspection, aided by a table of level cuttings, the area of any transverse section having the same ground slope as *a d*, the same base *b c*, and the same inclination of side slopes *a b*, *c d*.

For example, if it be required to find the transverse area of a cutting 5 feet deep, having the ground slope represented in fig. 2, from 5 follow the line 5 *s*, and from *s*, the line *s t*. Then the area corresponding to the depth *o t*, taken from a table of level cuttings, will give the area required.



It may be objected that this empirical method does not admit of mathematical accuracy, which I grant; but the same objection applies to any other method that can be devised, from the fact that the measures and transverse slopes themselves are never taken with mathematical accuracy. It is plain that a series of triangles, such as fig. 2, prepared to a scale of one-fourth of an inch to a foot, and having different ground slopes, will admit of a determination of the depth to be taken from the table of level cutting to within,

at most, the tenth of a foot, which is as close as is ever aimed at in practice. It will apply equally to ground slopes which vary, or are irregular in themselves. Though, in this case, it is necessary to have a diagram representing an entire transverse section of the cutting, or embankment, by means of which the *average* slope must first be obtained, by first drawing a line to represent a ground slope, which will equalize the irregularities, and the slope of this line being ascertained, must be used in its appropriate triangular diagram. It would, of course, be necessary to prepare a separate series of triangles for different widths of base, and for different side slopes.

The principal advantages which I conceive to attach to this method, is that it dispenses entirely with calculation, and thus precludes much liability to error; while, at the same time, it admits of great expedition. The principle of its demonstration is so evident, that I do not think it necessary to insert it.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Long and Short Connecting-Rods. By T. W. Bakewell.

In the Journal of the Franklin Institute for Feb., p. 86, may be found an essay on "The relative efficiency of Long and Short Connecting-Rods, considered in the exposition of crank and connecting-rod motion." This paper is copied from a foreign periodical, the "Civil Engineer and Architect's Journal." It is well and imposingly written, and the position taken by the writer, H. F. Clifford, is supported by an overwhelming array of algebraic formula. It begins with—"The subject of the following paper is one of great importance to the practical mechanic, and as we have never yet seen any satisfactory solution of this long disputed question, we have endeavored to draw such conclusions from the investigation of the theory of crank and connecting-rod motion, as, we feel convinced, will set at rest all previous doubt concerning the comparative advantages of long and short connecting-rods."

The *drift* of the piece is to establish an inferiority in effect, or, in plain language, a "loss of power," in the shorter connecting-rod, owing to its greater angle with the direction of the piston-rod; and that the forces transmitted through the rods L C, and S O, respectively, in their own directions, by any force in the direction of S L, are as the cosines.

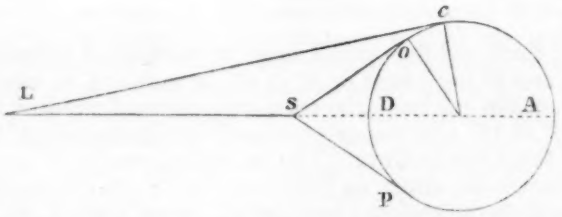
In the above it is, of course, intended that the cylinders be equal, and if the principle could be maintained, as stated, it would be perfectly practicable to construct an engine, worked with condensed air, and a long connecting-rod, which should pump back the used air into the receiver, through an equal cylinder and short connecting-rod, and leave an available surplus power.

Why is it that we set up our symbols against a law of nature, and seek to circumvent her, by a change in the proportions of our contrivances?

In a recent article in this Journal, bearing on another subject, the

following postulate is given: ***the required intensity of resistance, to balance a given force, is proportional to the obliquity of that resistance to the given force.*** This is true, and may be usefully impressed. It reverses the assumption of Mr. Clifford, and makes the transmitted forces through the connecting-rods, in their own directions, *inversely* as the cosines.

Let S P, be the short connecting-rod in its return, corresponding with its position at S O, and the piston-rod moving from S, towards D; then, by Mr. Clifford's theory, the force transmitted by the push, (thrust) through the connecting-rod, in its own direction, is decreased by the obliquity in the ratio of the cosines *directly*. But the arrangement of power and resistance is identical with what is called the "toggle joint press," acting downwards; and Mr. C. himself would admit, under this latter name, that the power moving in the direction of S to D, transmits, through the connecting-rod S P, in its own direction, a force increasing with the obliquity—in the ratio of the cosines *inversely*.



It must not be inferred that the above exhibit leads to a superiority in the short rod; the equality is shown in the completion of the act, and the greater efficiency near D, is but the compensation of what is withheld near A.

Cincinnati, 5th February, 1844.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

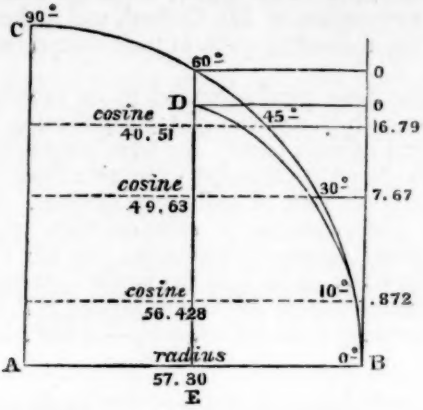
On finding Sine, Cosine, &c. *By* THOMAS W. BAKEWELL.

Tables for finding the sine, cosine, &c., when accessible, supersede other means for that end; but where they are not, the following rule is offered, as obviating, without the aid of logarithms, an elaborate process.

The following reasoning leads to the rule: Let B C, be a quarter circle of 90 units long, which gives a radius of 57.30; let B D, be the half of a corresponding cycloid, of which E D, is the base, produced to the circle at 60°. D B, of the cycloid is equal to A B. 57.30 radius of the circle. The ordinates 0.0 to the circle and cycloid, are equal 38.65.

Now it is the property of the cycloid, that its ordinates are as the squares of the included portions of the curve from B, and if we nominally reduce the portion of the circle at 60°, to that of the cycloid, and call it 57.30, and make equivalent nominal reductions at other points

of the circle below 60°, it, the circular arc, will also have its ordinates at those points, as the squares of the included portions from B.



But the circle and the cycloid may be considered coincident from 0° to 17°, and as the octant of 0° to 45°, is sufficient to establish the sines, &c., of the quadrant, the remaining space of required reduction is from 17° to 45°, and through these 28 degrees the ratio of reduction is nearly direct and uniform. The immediate results of the rule, are the ordinates to the circle, as .872 –7.67– 16.79, which may be termed *supplements to the cosines;* and which, being known, we find, by familiar process, the cosine, sine, versed sine, and chord, and, more remotely, other geometric properties, growing out of the relation of the circle to a straight line.

The rule is not perfect, and in giving the multipliers, small errors and fractions have been compromised in such manner as to combine, as far as possible, brevity with accuracy; but at no one point does the error exceed $\frac{1}{3600}$th part of the radius.

Rule to find the supplement to cosine from 0° to 45°, where radius is 57.3. From 0° to 17°, multiply the square of the degree in question, by the decimal .00872.

Example for 10°.

$$10^2 = 100 \times .00872 = .872 \text{ sup. to cosine.}$$

From 17° to 45° deduct from said .00872 as often .0000152, as the degree in question is above 17°, and with the remainder multiply the square of said degree.

Example for 30°.

$$13 \times .0000152 = .0001976 \text{ for deduction,}$$
$$.00872 - .0001976 = .0085224 \text{ for multiplier,}$$
$$30^2 = 900 \times .0085224 = 7.67 \text{ supplement to cosine.}$$

Cincinnati, 20th Feb., 1844.

On the Efflux of Gaseous Fluids under Pressure. By Charles Hood, Esq., F.R.S., F.R.A.S., &c.*

The theoretical determination of the velocity with which gaseous fluids are discharged, through tubes and apertures, under pressure, has often been submitted to mathematical investigation; and the subject being of importance in various branches of practical science, it is to be regretted that considerable differences exist in the results of the several formulas which have been propounded for its elucidation. Dr. Papin,† in 1686, first showed that the efflux of all fluids follows a general law; and that the velocities are inversely as the square roots of the specific gravities. Dr. Gregory‡ has likewise given various formulæ for calculating the velocities of air in motion, under different circumstances: and Mr. Davies Gilbert,‖ Mr. Sylvester,§ Mr. Tredgold,¶ and many other writers of equal authority, have also investigated the subject.

The hydrodynamic law of spouting fluids, has, by all writers, been applied in the calculations for the determination of this question. This law, it is well known, is the same as that of the accelerating velocity of falling bodies; and is proportional to the square root of the height of the superincumbent column of homogenous fluid. But although the various writers all agree in this fundamental principle, they differ materially in the modes of applying it, and in the several corrections introduced into their theorems; and the results they have arrived at are of a very contradictory character.

Dr. Gregory's formula for calculating the velocity with which air of the natural density will rush into a place containing rarer air, is based upon the velocity with which air flows into a vacuum. This is equal to the velocity a heavy body would acquire by falling freely from a height equal to that which homogeneous atmosphere would have, whose weight is equal to 30 inches of mercury. The height of this homogeneous atmosphere is 27,818 feet; and the velocity which a body would acquire by falling from this height (and, consequently, the velocity with which air will flow into a vacuum,) is $\surd(27.818 \times 64.36) = 1339$ feet per second. The density of the rarified air, divided by the density of the natural atmosphere, and this number, subtracted from unity, represents the force which produces motion; and the square root of this number multiplied by 1339 ft. (the velocity with which air rushes into a vacuum,) is the velocity with which the atmosphere will rush into any place containing rarer air.**

The method employed by Mr. Davies Gilbert, is also based upon the velocity with which air rushes into a vacuum, when pressed by a homogeneous atmosphere, equal to the weight of the natural atmosphere at the earth's surface. This supposed homogeneous atmosphere, is, according to Mr. Davies Gilbert's calculation, 26,058 feet; and the velocity with which air would rush into a vacuum when pressed

* Read before the Institution of Civil Engineers; and communicated by the author.

† Philosophical Transactions, 1686. ‡ Gregory's Mechanics, vol. i, p. 513. ‖ Quarterly Journal of Science, vol. xiii, p. 143. § Annals of Philosophy, vol. xix, p. 408. ¶ Tredgold on Warming Buildings, p. 76. ** Gregory's Mechanics, vol. i, p. 515.

by this weight, will be $\sqrt{(26{,}058)} \times 8 = 1295$ feet per second. When this calculation is applied to two columns of air of unequal density—as, for instance, the discharge of air through a chimney shaft—the height of the heated column of air, divided by the height of this homogeneous atmosphere, and the square root of this number multiplied by the velocity with which air flows into a vacuum, and this product again multiplied by the square root of the numbers representing the expansion of the heated air, will give the velocity in feet per second. The expansion of air, when heated, is found, according to Mr. Gilbert, by raising the decimal 1.002083, which represents a volume of air expanded by 1° of Fahrenheit, to the power whose index is the number of degrees which the temperature of the air is raised; or, it is equal to the fraction $\left|\frac{\overline{481}}{480}\right|^n$ n, being the number of degrees of Fahrenheit which the temperature of the ascending columns exceeds that of the external atmosphere.*

Mr. Sylvester's method of calculation proceeds upon the supposition that the respective columns of light and heavy air represent two unequal weights suspended by a cord, hanging over a pulley; and this mode of calculation gives a result very much less than by any other method.

The unequal weight of two columns of air is found by Mr. Sylvester in the same manner as by Mr. Gilbert. The volume of air expanded by 1° of heat, is equal to 1.00208; and this number, when raised to the power whose index is the excess of temperature of the heated column, gives the expanded volume of the air: and assuming the atmospheric density to be unity, we have

$$1 - \left(\frac{1}{1.00208}\right) e = d;$$

e, being the excess of temperature of the heated column, and d, the difference of density between the two columns. This difference of density multiplied by eight times the square root of the height of the tube, or shaft, containing the heated air, gives the velocity in feet† per second.

In Mr. Tredgold's theorum for calculating the efflux of air, the force which produces motion is assumed to be the difference in weight of a column of external, and one of internal air, when the bases and heights are the same. The difference of temperature of the two columns, by Fahrenheit's scale, divided by the constant number 450 *plus*, the temperature of the heated column, and this quotient multiplied by the height of the tube, or shaft, gives the difference in weight. Then, by the common theorum for falling bodies, eight times the square root of this number will give the velocity in feet per second; or accurately

$$V = \sqrt{\frac{64\frac{1}{3}\, h\, (t - x)}{450 + t}},$$

* Quarterly Journal of Science, vol. xiii, p. 113. † Annals of Philosophy, vol. xix, p. 408.

h being the height of the tube, t the temperature of the internal, and x the temperature of the external air.*

The method of calculations proposed by Montgolfier, appears, however, by recent experiments, to be the most accurate, as it is also the most simple of all the modes of determining this question. The difference in height must be ascertained which two columns of air would assume when the one is heated to the given temperature, the other being the temperature of the external air; and the rate of efflux is equal to the velocity that a heavy body would acquire by falling freely through the difference of height.

The space which a gravitating body will pass through in one second, we know to be 16.09 feet; but by the principle of accelerating forces, the velocity of a falling body at the end of any given time is equal to twice the space through which it has passed in that time, or the velocity is equal to the square root of the height of the fall, multiplied by the square root of 64.36 feet; or, again, to the square root of the number obtained by multiplying 64.36 feet by the height of the fall in feet.

When the *vis viva* is the difference in weight between two columns of air, caused by the expansion of one of these columns by heat, the decimal .00208, which represents the expansion of air by 1° of Fahr., must be multiplied by the number of degrees the temperature is raised, and this product again by the height of the heated column. Thus if the height of the column is 50 feet, and the increase of temperature 20°, we shall have $20 \times .00208 \times 50 = 2.08$ feet; or 52.08 feet of hot air will balance 50 feet of the cold air; and the velocity of efflux of the heated column when pressed by the greater weight of the colder column, will be equal to $\sqrt{(2.08 \times 64)} = 11.55$ feet per second.†

The efflux of air under any given pressure can also be calculated by the same means. For the pressure being known it is only necessary to calculate the height of a column of air which would be equal in weight to this pressure. Thus, if the pressure be equal to one inch of mercury, water is 827 times the weight of air, and mercury 13.5 times the weight of water; therefore, $827 \times 13.5 = 11164$ inches, or 930.3 feet: and, according to the preceding formula, $\sqrt{(930.3 \times 64)} = 244$ feet per second, for the velocity of efflux under this pressure of one inch of mercury.

In all these cases the velocity thus ascertained is independent of any loss by friction. A certain deduction must be made for this loss, which will vary greatly, according to the nature and size of the tube, or shaft, through which the air passes, as well as with the velocity of the air. Like all other fluids, the retardation of the air, by friction, in passing through straight tubes of any kind, will be *directly* as the length of the tube, and the square of the velocity; and *inversely* as

* Tredgold on Warming Buildings, p. 76.

† This, which is the usual mode of calculating the expansion of air, differs considerably from that already given, employed by Mr. Davies Gilbert, and Mr. Sylvester; and also from the formula of Dr. Gregory. The calculation of the latter is based on the expression $(1.376)\frac{x}{180} = V$, x being the required temperature, and V the volume at that temperature.—*Gregory's Mechanics*, vol. i, p. 486.

the diameter. This question, however, becomes very complicated under these circumstances, and particularly so when there are angular turns in the tube through which the air passes. The present state of our knowledge on this subject does not allow of any very accurate determination of the amount which ought to be deducted for friction from the initial velocity obtained by calculation; and it is only by empirical means we can arrive at an estimate of its amount.

We shall proceed now to ascertain how far these theoretical calculations agree with the results obtained by experiments.

In some new furnaces which Sir John Guest has lately added to his extensive iron works at Dowlais, some experiments have been made on the quantity of blast injected into the furnaces. In these experiments the machinery employed being new, and of the best construction, the loss occasioned by the escape of air through imperfections of the apparatus, was, perhaps, as small as possible. The engine for blowing the furnaces, made, at the time of the experiments, eighteen double strokes per minute. The diameter of the blowing cylinder was 100 inches, and the effective length of the stroke 7 feet 6 inches. From these dimensions, therefore, it appears that 14,726 cubic feet of air was taken into the blowing cylinder per minute; and the tubes through which it was discharged from the receiver, were six of 4 inches diameter, and six of 1¼ inch diameter: the area of all these tubes was, therefore, .5747 of a square foot, and the pressure of the blast, measured by a mercurial gauge, was equal to 4½ inches of mercury. Calculating by the formula already given, we shall have $\surd(827 \times 13.58 \times 4.5 \div 12 \times 64) = 519.2$ feet, which is the velocity per second; and this number multiplied by 60, and then by the area of the tubes, will give $519.2 \times 60 \times .5747 = 17903$ cubic feet of air discharged per minute. From this amount some deduction must be made for friction. The velocity of the discharged air is 354 miles per hour; and with this immense velocity, and through such small pipes, the friction is, no doubt, considerable. By deducting 18 per cent. from the calculated amount of 17,903 cubic feet, we shall have 14,681 cubic feet, which agrees within a fraction (namely 45 feet) with the quantity obtained by measurement.

In other experiments made at the same place, the following were the results:

The quantity of air which entered the blowing cylinder was the same as before, namely, 14,726 cubic feet; the total area of the tubes which discharged the blast was .5502 of a square foot, and the pressure of the blast was equal to four inches of mercury. The calculation, therefore, will be $\surd(827 \times 13.58 \times 4 \div 12 \times 64) = 489.5$ feet per second: and, therefore, $489.5 \times 60 \times .5502 = 16.159$ cubic feet discharged per minute. The velocity of the blast, in this case, was 333 miles per hour; and if we deduct for friction 9 per cent. from the calculated amount, the remainder is exactly the quantity of air which is ascertained, by experiment, to be discharged through the tubes.

In a work published in 1834, by M. Dufrenoy, being a report to the Director General of Mines, in France, on the use of the hot-blast in the manufacture of iron in England, the results are given of many

similar experiments to the above; but, with two exceptions, the details are not sufficiently ample to found any calculations upon. The two exceptions named are the furnaces at the Clyde, and at the Butterley Iron Works, when they were blown with cold air. Both these blowing machines are described as having been in use for several years; and it is, therefore, natural to suppose the various parts were more worn, and fitted less accurately than in those experiments already described. The experiments were also made with less care. They show a different result to those already detailed; as in these the calculated quantity of air appears to be less than the quantity which entered the blowing cylinders in about the same proportion as it exceeded it in the former cases. The difference, no doubt, arises from the imperfect fitting of the piston of the blowing cylinder, which, by allowing a portion of air to escape, would diminish the apparent pressure on the mercurial gauge placed at the further extremity of the apparatus, and thence the calculated rate of efflux would, of course, be diminished.

In the experiments at the Clyde Works, the quantity of air which was discharged into the furnace, when estimated by the quantity that entered the blowing cylinder, was 2827 cubic feet per minute. The pressure of the blast was equal to six inches of mercury, and the area of the tubes .0681 of a cubic foot. Calculating the discharge of air under this pressure, it amounts to 2450 cubic feet, being 13 per cent. less than the measured amount, supposing no loss to occur by imperfect fitting of the apparatus.

At the Butterley Works the quantity of air discharged into the furnace, estimated by the contents of the cylinder, was 2500 cubic feet per minute. The pressure of the blast was equal to five inches of mercury, and the area of the tubes .0681 of a cubic foot. The quantity, by calculation, appears to be 2235 cubic feet, being less by 10½ per cent. than that shown by experiment. In both these last cases, however, there is but little doubt that the loss of air from the cylinder caused the pressure on the mercurial gauge to be less than it would have been, had the apparatus been perfectly tight; and a very small diminution in the observed height of the mercury would account for a much greater difference in the velocity of efflux than is here shown.

We are fully warranted in the conclusion, from these experiments, that this method of calculation is as accurate as any theoretical determination of such a question can be; but, from the results so obtained, an allowance must always be made for friction, which will necessarily vary with the peculiar circumstances of each case.

The following table will exhibit the results of the preceding experiments at one view:—

TABLE I.

Place and Number of Experiments.	Pressure of blast in inches of mercury.	Area of tubes, (square feet.)	Velocity of blast, (miles p. hour.)	Quantity of air by experiment, (cubic feet.)	Quantity of air by calculation. (cubic feet.)	Difference in quantity, (per cent.)
Dowlais, No. 1,	4.5	.5747	354	14726	17903	+ 18
Do. No. 2,	4.0	.5502	333	14726	16159	+ 9
Clyde, No. 3,	6.0	.0681	408	2827	2450	— 13
Butterley, No. 4,	5.0	.0681	372	2300	2235	— 10.5

In order to show the results of the several modes of calculation which different mathematicians have adopted, the following table has been calculated from the data given in experiment 2 of the preceding table; and it shows how far the several modes differ from each other in their results:—

TABLE II.

Place of experiment.	Pressure of blast in inches of mercury.	Area of tubes, in square feet	Quantity of air by experiment.	Quantity of air Discharged (by calculation.)				
				Montgolfier.	Gregory.	Gilbert.	Sylvester.	Tredgold.
Dowlais,	4.	.5502	14,726	16,159	15,152	14,855	5,017	15,555

Considering the amount of friction which must result from the discharge of air, at the immense velocity which was obtained in this experiment—viz., 333 miles per hour—and also that some of the tubes were only 1¼ inch diameter, it would probably be considered that the highest of these calculations is the nearest the truth, as it only allows of a reduction of 9 per cent. being made for friction to reduce the calculated amount to the quantity obtained by experiments. It may, therefore, be concluded, that the method which gives this result is the most accurate, as it is also the most simple, for general use.

Lond. Mining Journ.

Description of the new Dock Gates at Grangemouth, on the Forth. *By* JAMES THOMSON, Esq., C. E., Glasgow.

Mr. Thomson exhibited a model and drawings of the dock gates recently constructed at Grangemouth, where the entrance lock, upon which are four pairs of gates, is 250 feet long, 55 feet wide, with a depth of 25 feet water over the sill into the new wet docks. The gates, which are wholly built of timber, consist of a double framework, the front framing, or that next the sill, being straight, and the back curved, both, of course, uniting together in the heel and meter posts. The back, or curved framing, is formed with arched ribs, composed of plank in three thicknesses of four inches, firmly bolted together, and to the corresponding front ribs; this double framework, being braced together with horizontal, and diagonal, tension rods of iron, is planked on both sides, and made perfectly water-tight. The gates constructed in this manner are extremely light and buoyant; and by the admission of more, or less, water, with additional balance weights, the buoyancy of the gate is so adjusted, that its whole weight is borne by the water, and, consequently, very little power required for opening and shutting, besides the great saving in tear and wear, thus reduced to a minimum; in proof of which it was stated, that instead of from ten to twelve minutes, with four men, the time and power usually required for opening, or shutting, gates of similar dimensions, these gates, by means of improved crab gearing, are opened, or shut, in three and a half minutes, with only two men; and with a longer allowance of time, even one man is able to work them. Thanks voted, and given from the chair.—*Trans. Roy. Scot. Soc.*

Civ. Eng. & Arch. Journ.

Observations upon Iron Lattice Bridges. *By* JAMES THOMSON, Esq., C. E., Glasgow.

Mr. Thomson illustrated his observations with numerous drawings and models of several lattice bridges already completed, or at present carrying into execution, by Mr. Macneill and himself. The principle of lattice bridges, applied in timber, has, for some time back, been in use in America; but the adaptation of the principle to iron bridges, as now so successfully applied by Mr. Macneill and Mr. Thomson, is likely to supersede, in a great degree, the use of timber, and will supply a desideratum hitherto felt in establishing internal lines of communication, &c., where the expense of stone bridges not unfrequently precludes their being carried into effect, while the objection to wooden structures, on the score of durability, is obviated by the substitution of iron. The first bridge of this kind, recently completed by Mr. Macneill, on the line of the Dublin and Drogheda Railway, and of which drawings were exhibited, is 85 feet in span, consisting of two lattice-work frames, or beams, one on each side, resting upon stone abutments; the lattice-work beams are composed of small bars of malleable iron, about 12 feet long, and only a quarter of an inch thick, placed

so as to cross each other at right angles, and forming a net, or lattice-work, riveted at every intersection; the lattice frames, so constructed, and stiffened with angle iron, support the roadway by means of light transverse beams, also of malleable iron, secured to the lattice-work at each end. This bridge, which altogether weighs only fourteen tons, sustained a load across its centre of twenty-four tons, under which the deflection amounted only to 3-10ths of an inch.* A viaduct 230 feet in length, with a central span of 140 feet, is now being constructed by Mr. Macneill, over the Royal Canal in Ireland, for heavy locomotive traffic. This viaduct, of which Mr. Thomson exhibited drawings, has a third lattice frame in the centre, and is composed of malleable iron bars half an inch thick. Mr. Thomson described a very useful application of this principle to the widening of the roadways of existing bridges; and exhibited a prettily constructed model of one of the arches of a stone bridge, about 400 feet long, with the addition of footpaths on each side, as at present executing under his direction, the old width of roadway being only 17 feet, while, with the new footpaths, supported by iron lattice-work, the width will be increased to 30 feet. The appearance of these bridges, which may be either perfectly straight, or slightly curved, as circumstances require, is light and graceful, combining, as they do, great strength with the least possible quantity of materials, and seem to be admirably adapted for crossing wide and deep valleys, rivers, &c., at a small expense, as also for ornamental bridges in parks, or approaches to gentlemen's seats, &c. The expense of construction, Mr. Thomson estimates at less than half the cost of stone; but he stated that he was at present making an investigation into their principle, with experiments upon a different arrangement of the lattice-bars, which he hoped would lead to a considerable saving, both in the quantity of material and workmanship.—*Trans. Roy. Scot. Soc.* Ibid.

Description of a Cast-Iron Bridge over the Avon, near Tewkesbury, on the line of the Birmingham and Gloucester Railway. By Capt. W. S. Moorsom.

The principal novelty of this work, which was proposed, and its execution superintended, by Mr. Ward, of Falmouth, is the mode of constructing the two piers, which were externally of cast-iron, in the form of caissons, each weighing about twenty-eight tons; the plates composing each caisson were put together on a platform erected upon piles over the site of the pier: the bottom of the river being leveled by a scoop-dredger, the caisson was lowered, and, some clay being thrown around the exterior, a joint was formed, so nearly water-tight, that two small pumps drained it in six hours. The foundation being then excavated to the requisite depth, the caisson, which sank as the excavation proceeded, was filled with concrete and masonry; cap plates were then fixed for supporting eight pillars, with an entablature,

* The cost of this bridge, including the stone abutments, was £510; the lattice bars are $2\frac{1}{2} \times \frac{3}{8}$, the lattice frames 10 feet deep, and the floor line is $5\frac{1}{2}$ feet above the bottom.

to which was attached one end of the segmental arches, 57 feet span, with a versed sine of five feet two inches. There were three of these arches, each formed of six ribs of cast-iron, and two such piers as have been described, the land abutments being of stone work, joining the embankment of the railway. It was stated that this mode of construction was found to be more economical, in that peculiar situation, than the usual method of fixing timber coffer-dams, and building the piers within them, the total cost of the bridge being only 10,192*l.*, and the navigation of the river was not interrupted during the progress of the work. The paper was illustrated by eighteen drawings by Mr. Butterton.—*Trans. Inst. C. E.*

Lond. Athenæum.

The Screw Propeller—Steam Navigation.

At the last meeting of the Liverpool Polytechnic Society, the president, John Grantham, Esq., C. E., in the course of his annual address, said, that finding that he had but few observations to make on the state and prospects of the Society—so even had been the tenor of its way through all the changing scenes of the times—he should introduce to their notice a topic of public interest, suited to the character of their meetings: the subject he alluded to was the present state of steam navigation. After some introductory observations, as to the failure of the science as a profitable mercantile speculation, he called their attention to the screw propeller, as a substitute for paddle-wheels—an improvement which he had great hopes would do much to place steam navigation on a firmer foundation. Several short notices of the screw propeller had appeared in scientific publications, [see *Mining Journal* of the 28th October, for a detailed description, with diagram,] but they were very imperfect, and little could be gleaned from them. It had, however, been referred to more satisfactorily, in a paper written by Mr. Elijah Galloway, the patentee of paddle-wheels, in an appendix to Tredgold's work on the steam engine. But the author had not formed a decided opinion on the question, and did not establish its superiority. The French claimed to be the original inventors of the screw propeller, and few would dispute with them the honor on this point—though they also claimed the steam engine, which was due to the English. The lecturer here referred to a French paper detailing the performances of the French war steamer *Napoleon*, which were certainly satisfactory, and next noticed a number of instances in which the screw had been employed, even from the year 1699. It was also tried by different parties in 1743 and 1763. In 1802, the *Doncaster* transport, which had been becalmed, was worked into harbor, at Malta, at the rate of one and a half mile per hour, by eight men at a spell. She went seven leagues with a screw, and the parties seemed to have contemplated every kind of propeller since patented by others. In 1825, the screw was applied to a vessel in the Thames. In 1828, a patent was taken out for a screw by Mr. Charles Cummerow. In 1832, M. Sauvage also

applied it. In the same year, Mr. Woodcroft, of Manchester, took out his patent; in 1836, Mr. Smith his; and in 1838, Mr. Ericsson also obtained one. Cummerow's and Smith's were much alike. Mr. Grantham then explained the principle of the screw, or inclined plane, and its advantages over the paddle-wheel, assuming, for argument's sake, that simply as a propeller, there was no preference to be given to either. He referred to cross sections of two vessels of the same dimensions, one with the paddles, and the other with the screw; also to longitudinal sections of the same. By pointing to these, he clearly showed the several advantages of screw vessels. There were several kinds of screw propellers, but the principle was the same in all—an inclined plane turned round a spindle, or cylinder. (This he showed by wrapping a piece of paper, in the form of a right angled triangle, round a roller; and the hypotenuse, or slanting edge, of the paper, described the worm of the screw, which might be made of any pitch.) And if a screw were made to revolve in a solid, by giving it one revolution, it would move forward, or backward, a distance equal to the pitch. There might be several threads in the same screw, but although this constituted a difference in form, the principle remained unaltered. Mr. Smith's first experiments were made with a single thread, or incline, wound round an axis, making an entire revolution, and presenting to the eye, when looking in the direction of the axis, the form of a complete disk. Ericsson's, and others, consisted of a short portion of the screw, with many threads, or inclines, in some cases appearing to the eye when placed in the direction of the axis, as a complete disk. (He here described the number of blades on the screw, and how they were formed.) Woodcroft, who obtained his patent in 1832, adopted a slightly different system. Instead of the thread being uniform, and the incline the same at all points, he proposed an increasing pitch at the after end. His object would be understood by considering a fish's tail, more particularly that of the eel. In the evolutions made by its body and tail, they each continued to increase; and, consequently, the rapidity with which it struck the water increased also, and compensated for the loss of effect occasioned to the tail by the motion given to the water by the body. In like manner, by giving this constantly increasing angle to the screw, the same result would follow. This he (Mr. Grantham) conceived to be a very beautiful modification of the original screw propeller. The principle did not escape the attention of others; and it was to be regretted that it had not been tried earlier, and made known. He had alluded to the plans of Messrs. Smith, Ericsson, and Woodcroft, to the first two as being best known, and because he believed the award of superiority, was, by almost common consent, given to it. Mr. Smith was the originator of a company that built the *Archimedes*—a vessel that circumnavigated England, and performed other long voyages. She first drew public attention to the subject. Great credit was due to that spirited company, and to Mr. Smith, for these experiments, which were conducted on a liberal scale; but this was not the first vessel that had been propelled by a screw. Ericsson had previously done much, and displayed great originality of thought. The form of his

propeller, although not the subject of this patent, had never yet been surpassed, and it required only the elongated pitch to make it the most efficient yet constructed. He, the lecturer, was influenced by this opinion, when recently called upon to construct the small vessel called the *Liverpool Screw*, which had been at work on the Mersey. He had taken care not to infringe any patent on the screw he adopted, and was surprised to find, on looking over the list, that these valuable plans had been overlooked. Several experiments had been made by Messrs. Brunel, Claxton, and Guppy, at Bristol, under the superintendence of the latter, upon various forms of screw in the *Archimedes*. In these some curious facts were observed, and it was then suggested that it was possible to propel a vessel faster by the screw, than the screw itself would have gone, had it worked in a solid medium. He at first conceived that there was an error in the calculations, but subsequent observation induced him to believe it possible to obtain such a result, and that all vessels having the screw in the dead wood, or run, have a tendency to go faster than the theoretical calculation would lead us to expect—though if this tendency were increased, it would be at a loss of power. He accounted for it by the manner in which water fell into the vacancy left as the vessel passed onward. A similar operation might be observed in watching the eddy formed by the pier of a bridge, in which case the body was stationary, and the water moved, but their relative positions were the same in both. The conclusion, therefore, was, that though the relative effect between the screw and the vessel appeared to be favorable, yet that being obtained at a great sacrifice of power, such a result might arise from defects in the form of the vessel, and was, therefore, no good indication, and that the utmost efficiency would be obtained, when the speed of the screw was from one-fifteenth to one-twentieth part greater than that of the vessel. The lecturer then noticed some of the most remarkable screw vessels that had yet appeared, and the forms of the propellers employed, and considered the difficulties that opposed the general introduction of the screw, and showed that some of the objections to it were groundless. He showed, by diagrams of two vessels of equal size, that where paddle-wheel vessels could not easily have any beams over the engine room, on the plane of the lower deck, as the engine, &c., rose to the deck above, beams might be introduced in screw vessels at that point, not only greatly strengthening the vessel where she most wanted it, but admitting of a clear range of saloons, or cabins, fore and aft, with little, or no, interruption.

A short, interesting discussion took place, in the course of which the chairman ably and convincingly replied to the questions propounded, on the supposed lateral pressure of the screw.

Mining Journal.

English Patents.

Information relative to the process and cost of procuring Letters Patent within the British Dominions. From the circular of NEWTON & SON, *Patent Agents, London.*

The United Kingdom of Great Britain and Ireland, is, as far as regards patents for inventions, divided into three distinct countries, for each of which separate patents must be obtained by any inventor who wishes to protect his invention throughout the whole of the British Dominions; but a patent for either country alone may be obtained without reference to the other two. All British patents are granted for the term of fourteen years; and the expense of obtaining them, as well as the time required to pass the papers through the different offices, varies in some slight degree, according to the time of year at which the application is made.

The average, or *ordinary*, cost of patents for England and Wales, Ireland, and Scotland, if unopposed, and passed in the ordinary manner, without extra fees, but including the agent's commission, is as follows:—

For England and Wales,	about	£110
Scotland,	do.	82
Ireland,	do.	134*

If no opposition is entered against the delivery of these patents, they may be generally obtained in about three weeks, or a month.

In order to protect an invention in the British colonies and possessions, including the channel islands of Jersey, Guernsey, Alderney, Sark, and Man, the inventor must signify his intention to that effect at the time of petitioning for his English patent; and this extension of the patent right will increase the expense of an English patent about £5, thereby making it cost altogether about £115. The attention of patentees is particularly directed to this point, as, in the event of the English patent being granted without including the colonies, the inventor must apply for a new patent for the latter alone, at an expense nearly equal to the original cost of the English patent. Any person, or persons, whether British subjects, or foreigners, may, if resident in the United Kingdom, obtain a patent for any invention that is new in the British Dominions; and no difference whatever, either in the cost of a patent, or the amount of protection it affords, is made between British subjects and foreigners, and no peculiar restrictions are imposed on the latter, as is the case in many foreign countries. The previous publication and use of an invention abroad will not invalidate a patent obtained subsequently in the United Kingdom, provided the invention is new in this country at the date of the patent.

* By a recent act, whereby the stamp duties in Ireland were assimilated to those in England, the cost of an Irish patent was increased £10, thereby making it the amount stated above. Before the passing of this act, the stamp duty on an Irish patent was £20, but the stamp on an English patent being £30, that on the Irish now becomes the same.

In applying for a patent, the inventor, or applicant, is not required to give any *detailed* description of the invention, or improvements; he has merely to sign a declaration in the presence of a Master in Chancery,* affirming that he has invented, or is in possession of, an invention for something, such, for example, as "*certain improvements in steam engines;*" and that the invention is not known, or in use, within these kingdoms to the best of his knowledge and belief. This declaration is accompanied by a petition to the queen, setting forth the same thing, and praying that her majesty will be pleased to grant him Letters Patent for the said invention. Upon this two-fold document being deposited in the proper offices, every person having a caveat at all bearing upon the invention, is immediately informed that an application has been made, by certain parties, for a patent in England, Scotland, or Ireland, as the case may be, for "*certain improvements in steam engines;*" that if they consider that the said invention will interfere with the subject of their caveat, and desire to oppose the grant, an opposition must be entered within seven days from the date thereof, otherwise the patent will proceed.

If no opposition is entered, the patent will be granted in the course of a few days; but if the proprietor of some caveat, imagining that the application will interfere with his invention, should enter an opposition, the Attorney, or Solicitor, General will appoint some day, generally about a week in advance, when he will hear both parties separately, and in private, and examine their inventions, so as to determine whether the two inventions clash; and if, upon examination, the Attorney, or Solicitor, General, shall decide that the two inventions are alike, the grant of a patent will be refused to either party, until some amicable arrangement is entered into, as to their mutual interests; but if the inventions are found to be dissimilar, the patent is allowed to proceed, upon condition that the petitioner deposits a description of the main features of his invention with the Attorney, or Solicitor, General, by whom it is officially sealed up, until the enrolment of the petitioner's specification: after which time any person can procure an office copy of the deposited document, including the drawings, if any, at a moderate expense; and if the enrolled specification is not found to agree, in the main points, with the description deposited with the Attorney, or Solicitor, General, the patent may be attacked at law, upon the ground of fraud upon the Crown, as the patent is granted upon the report of the law officers of the Crown, for the invention described in the deposited document, and for nothing more that is really, substantially, and essentially different. It must not, however, be considered, that the patentee is tied literally to the description which he has deposited, and is, therefore, precluded from making any trivial alterations, or improvements, upon his invention; it is merely intended to be a check upon dishonest persons, and prevent such a one from availing himself of another party's improve-

* In London there is a proper office in which these declarations are made, but in the country almost every solicitor is empowered to witness the signature of this and other documents having reference to any business in Chancery, consequently there is no necessity for the personal attendance of the inventor in London.

ments, and, in fact, specifying an invention altogether different from that for which his patent was granted.

It may be here remarked that as the opposing parties are heard separately in a private room, neither can become acquainted with the particulars of the other's invention. The costs attending an opposition fall equally upon the applicant and his opponent, each party paying the official fee of £3 10*s.*; and in order to prevent vexatious opposition, the latter is called upon to pay his costs at the time of entering his opposition, and the former pays for the hearing when the meeting takes place. If there are two, or more, oppositions against one patent, they are all heard seriatim at the same sitting, and a separate official fee, of the above amount, must be paid for each opposition; the applicant, however, only pays one fee for the hearing, whether there be but one, or fifty, oppositions.

A caveat is a memorandum, inscribed upon the books of the offices through which all patents must pass, calling upon the clerks to give notice to the proprietor thereof, of every application that is made for a patent having any reference to the subject for which the caveat is entered. This caveat remains in force twelve months, costs £1 1*s.*, and may be renewed annually.* Caveats are sometimes entered for particular manufactures, or trades, such as spinning, weaving, candle, or soap, making, purifying oils, &c., by persons engaged, or interested, in those particular branches of trade, merely for the purpose of being informed of all the improvements that are taking place, but without any ulterior intention of opposing any particular application, or obtaining a patent themselves.

Patents may be, and sometimes are, opposed at a subsequent stage, when the proprietor of a caveat has, from some cause, neglected to enter his opposition at the proper office; but when this is the case, the oppositionist must enter what is called a special caveat: he is further obliged to pay the costs on both sides, and also defray any expenses that the petitioner may have incurred since the time that the opposition ought to have been entered in the regular manner. This, however, is of rare occurrence, as the opposing party is obliged to deposit the sum of £30 in the hands of the Attorney General, in order to meet the costs of the opposition, and the extra expenses above mentioned: and if the opposition is successful, the whole of the £30 is forfeited; but if the patent is still allowed to proceed, the balance, after deducting the Attorney General's fees, is paid back again to the opposing party.

Although, as was before stated, a complete specification of the invention is not absolutely necessary, upon making application for a patent, yet, when an inventor, *residing abroad*, is desirous of obtaining British patents, he should furnish the agent with a complete and detailed description of the invention, accompanied by correct drawings, if necessary. For the full protection of the inventor's interest,

* As the nature and object of a caveat is not well understood by inventors generally, it may be as well to observe, that it is a private document, and gives no kind of priority, as has been erroneously supposed, neither does it form any part of the progress of a patent, and is not essentially connected therewith. It is merely a precautionary measure, whereby immediate notice is obtained of interfering applications.

this description ought to be, in every way, as complete as if he were applying for a patent in his own country; as in the event of any opposition being made by parties in this country having the same object in view, the agent may then be enabled to remove such obstacles to the grant of the patent. From what has been stated as to the nature and use of a caveat, it will be seen, that it is perfectly useless for any inventor, residing more than three days' post from London, to take this step alone, as the time allowed for entering an opposition against any conflicting claim, would expire long before an answer to the notice could be returned.

The most politic course for an inventor to pursue, in the event of his having some invention, or improvements, which he may ultimately wish to protect by patent in the United Kingdom, but of the success of which he is not perfectly certain, is to take the preliminary steps to secure a patent for England, and make the application in the regular manner, as if it were his intention to obtain the patent in due course. This step, which would not cost more than £10, if unopposed, and forms part of the ultimate expense of the patent, would carry his application past the stage where oppositions usually occur. Having arrived at this stage, the application may be suspended for a while, until the inventor has had an opportunity of *privately* testing his improvements; and when convinced of the value, and probable success of his invention, he may then proceed to complete the patent. It must, however, be borne in mind, that taking this preliminary step will not entitle the patentee to publicly make, use, or sell his invention, as any exposure of this kind, before the patent is actually sealed, will endanger its validity; his experimental trials, therefore, must be strictly *private*. It is also advisable not to expose the invention to view before the sealing of the patent, as such a public exhibition would be unnecessarily dangerous, and might as well be avoided.

When an application for a patent is made by more than one person, the expense is materially increased, an extra fee being charged at several of the offices for every additional name, amounting in the whole to about £20 extra for the second name, and a further sum of nearly the same amount for every additional name.

The documents on which the grant is founded having been duly passed through all the proper offices, the patent is eventually sealed, by the Lord Chancellor, with the Great Seal of England, in the case of an English patent; and, for this purpose, certain days, called "*public seal days*," are appointed by his lordship, and on those days *only* can patents be sealed, except by payment of an extra fee, which, if the Lord Chancellor happens to be in town, will not exceed £2; but if, as is often the case during the vacation, his lordship should be out of town, a further expense is incurred for a journey to his lordship, according to the distance he resides from London. When patents are, in this manner, sealed on other than the appointed days, they are passed by what is termed a "*private seal*."

The mode of procedure, in making applications for Irish and Scotch patents, is similar to that above described in reference to English patents; but Irish patents are sealed by the Irish Lord Chancellor,

with the Great Seal of Ireland; and Scotch patents with the seal appointed by the Treaty of Union, to be used in place of the Great Seal of Scotland.

The exclusive right to use, or dispose of, the invention, is vested in the patentee from the day on which the patent is sealed, and he, or his licencees, without endangering the validity of the patent in the slightest degree, and prior to the enrolment of the specification, can immediately make, use, or sell, his invention, or the produce thereof; and any person using the same, or vending articles resembling the invention, or purporting to be produced thereby, without licence, or consent, from the patentee, becomes liable to an action for infringement.

To save the trouble, loss of time, and expense of a journey to England, foreigners can obtain patents in the United Kingdom, for their inventions, in the name of any friend who is a resident in this country; or, if preferred, inventions may be patented, as is often the case, in the name of an agent, as a communication from a foreigner, and subsequently assigned to the inventor abroad, or to any other person that he may appoint.

All patents for inventions are granted upon certain conditions, with which the patentee must comply, upon pain of forfeiture of the grant. One of these conditions is, that he shall, within a certain time, (generally six months,) from the date of the patent, enrol a specification, or description, of the invention. This document must clearly and intelligibly explain and point out the nature of the invention, and also the manner of carrying it into effect. Neglect to enrol the specification within the proper time; furnishing an incorrect, or unintelligible, description of the invention, either by ignorance, or with intent to mislead the public; or withholding any information that is absolutely necessary for perfectly understanding the invention, involves the forfeiture of the grant, and, of course, the loss of the fees paid for the patent.

The obligation to enrol a specification, or description, of the invention, is intended to effect a double object; namely, first, to inform other inventors in what the improvements consist, and thereby prevent them from patenting a similar invention, or infringing upon one already protected; and secondly, that when the patent expires, such a description of the invention may remain on the record, as will enable any other party to carry the improvements into operation without the assistance of the original inventor. As a patent, or exclusive privilege, to make, use, or sell, an invention, for fourteen years, is granted to the author, upon condition of his divulging the secret, for the use of the public after the expiration of the patent right, any ambiguity in the description, or attempt to mislead the public, whereby the patentee may seek to retain any advantage to himself, after the fourteen years, will, as before mentioned, involve the forfeiture of the grant, as the patentee does not then act up to his contract. More patents have been declared void from inaccuracy, and insufficiency of the specification, than for any other cause; and, therefore, it is of

the greatest importance that the specification should be carefully drawn up by a person conversant with such business.

As many inventors erroneously conceive, that by enrolling the specifications of their inventions before others who have patents for similar inventions, sealed a short time previous to them, they will gain the advantage of priority, it must be distinctly understood, that no advantage whatever can be thereby obtained; in fact, it is, on the contrary, an unnecessary and premature exposure of the invention, and may, in some cases, prove injurious in the highest degree, to the interests of the inventor, or patentee. The delay of six months, from the date of the patent, for the preparation and enrolment of the specification, is granted to the patentee, on purpose to give him the opportunity of making such trials and experiments, on a large scale, as will enable him to perfect any of the details of the invention, and, therefore, enrol a specification comprising all his recent improvements. Now, as a patent bears date, and the exclusive right commences, from the day on which it is *sealed*, as before mentioned; and as nearly all patentees are allowed six months for the enrolment of their specifications, it will be easily understood, that if two persons obtain patents under the same title, say "*certain improvements in steam engines*," at different dates, the inventor, whose patent is first sealed, can, if he obtains any information of the invention of the second party, avail himself of it in the preparation of his specification. For example, let us suppose that the patent of one inventor, A, is sealed on January 1st, while that of another person, B, for a similar object, bears date February 1st, both being allowed six months for enrolment: if B, enrols his specification on March 1st, and, therefore, previous to A, erroneously supposing, as inventors sometimes do, that by adopting this course, he will thereby anticipate the latter, and obtain some advantage over him, B, not only does not improve his position, but virtually puts his rival A, in possession of full particulars of his invention, or enables him to obtain them, as, immediately the specification is enrolled, the latter, or any other person, may either inspect it, upon payment of a small fee, or, if he thinks proper, procure an office copy of it, and extract therefrom any portion which he may consider important, or likely to prove useful to himself; and although this may appear to be a flagrant act of injustice, it would be next to impossible to obtain any remedy, if the piracy were cleverly managed, as the second patentee voluntarily puts himself in a position that he has no occasion to occupy, and, in fact, ought not to assume. It may be argued that the publicity given to the invention, from making the necessary experiments and trials above mentioned, is, of itself, sufficient to explain the improvements to any intelligent person, and, in some cases, it undoubtedly is; but there is no occasion to add to this, by enabling parties to obtain a correct description and drawings of the invention, whereby they can ascertain all the peculiar features of novelty, especially as no possible advantage can be derived therefrom. For the above reasons, therefore, it will be at once understood, that if, when an inventor has obtained his patent, other patents for similar subjects remain unspecified, it is not only advisable to refrain from

enrolling until the last day, or two, of the six months, but all unnecessary publicity should, as far as possible, be avoided. If no interfering inventions are in the way, of course, this latter caution is unnecessary.

The specifications of English, Scotch, and Irish patents, must be engrossed on stamped parchment; the first skin bearing a stamp of £5, and every additional one a further stamp of £1. The amount of fees payable on enrolling the specification in the High Court of Chancery, will, of course, depend upon its length, consequently it would be impossible to give a correct estimate of the expenses of preparing and enrolling a specification. There are, in London, three different offices in which the specifications of English patents may be legally enrolled, namely, the Rolls Chapel Office, which contains the records from a very early date; the Inrolment Office, and the Petty Bag Office. The fees of enrolment differ in each of these offices, the charges at the Rolls Chapel Office being considerably less than either of the others; but there are some official regulations connected with the latter office, which some patentees think objectionable. The specifications of Irish patents are enrolled in Dublin, and those of Scotch patents in Edinburgh. Before the passing of the New Stamp Act, whereby the stamp duties of England and Ireland were assimilated, Irish specifications bore a stamp of £1 on each skin; but by the recent Act, an additional stamp was added, making it now £5 on the first skin, and £1 on every following one, as in England and Scotland. In addition to the stamps and fees above mentioned, it may be necessary to prepare drawings to accompany the specification—this again adds to the cost. But in order, however, to give inventors some idea of the probable expense, we may mention that when the description is of moderate length, and does not exceed one skin, accompanied with an explanatory sheet of drawing, it may be fairly taken at from £15 to £20. The total cost of patents for the whole of the British dominions, if unopposed, and obtained under *ordinary* circumstances, will, therefore, be as follows:—

England, Wales, and the Colonies, and the Channel Islands, ...	£115
Scotland, ...	82
Ireland, ...	134
Three Specifications, say £15 each, . .	45
Total, ...	£376

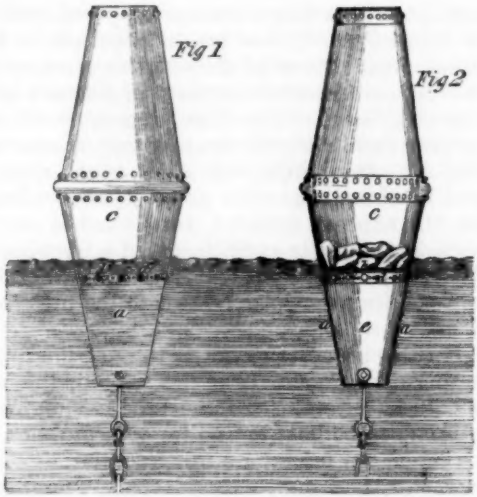
Specification of a Patent granted to WAKEFIELD PIM, *of the county of York, for his invention of certain improvements in the construction, or formation, of Buoys, or other water marks. Sealed 18th March,* 1843.

These improvements consist in so making, or constructing, buoys, or water marks, that they may be rendered more efficient in service,

in consequence of greatly increasing the lightness, or buoyancy; and also reducing the amount of ballast with which they are usually charged, to enable them to preserve their erect position in the water. Buoys made in the ordinary manner, when of considerable size, with closed ends, top and bottom, require several hundreds weight of ballast to bring them "over end," or cause them to float in an erect position, or nearly so, in the water, which ballast, or weighting, compels the buoy to be immersed fully one-half in the water.

One of the most important objects of a buoy, is that it may be seen as far off as possible, and, consequently, the less it is hidden by immersion, of the greater service it becomes. And another great feature in its construction is lightness; as by weight, the difficulties of mooring and unmooring the buoy are much increased.

In order to effect these important objects, the patentee constructs the buoy in the peculiar manner exhibited, in which fig. 1, is an external elevation of a buoy, or water mark, and fig. 2, a section, taken vertically through the middle of the same.



The invention consists in forming the buoy with its lower end *a a*. open, for a certain space, so that it may be admitted into the water with little, or no, resistance, and in introducing the bottom, or closing plate *b b*, at nearly one-third of the length of the buoy upwards, so as to close the chamber, or space, *c*, and support the necessary ballast. There are apertures *d d*, made just below the bottom plate *b*, for the purpose of allowing the air to escape, that the lower compartment, or space, *e*, may be entirely filled with water; thus the ordinary ballast, or weighting, may be reduced to about one-third of that usually employed, as the water itself will sufficiently steady the buoy, and retain it in the desired position. It will be evident that buoys so constructed will float much higher out of the water, owing to their increased

buoyancy, and, consequently, be seen, by an observer, at a much greater distance than those in ordinary use, and also be kept much steadier, particularly in a rough sea, or tide, way.

The patentee claims the construction, or formation, of buoys, or water marks, having the lower end open for the admission of water for a certain space, and apertures at the upper part of the open compartment, to allow the air to escape, as herein particularly set forth and described, and also shown in the drawing, whether such buoys, or water marks, be made of iron, wood, or other materials.—Enrolled in the Petty Bag Office, September, 1843.

Lond. Journ. Arts & Scien.

Mechanics, Physics, and Chemistry.

On a re-arrangement of the Molecules of a Body after Solidification. By Robert Warington, Esq.

Having occasion lately to prepare some alloys of lead for the purpose of lecture illustration, I was much surprised at an alteration taking place in the arrangement of the particles of one of these alloys, as shown by the appearance of the surfaces of fracture, after the metal had assumed the solid form. The alloy experimented on was that known as Newton's fusible metal, composed of 8 parts of bismuth, 5 of lead, and 3 of tin. On pouring this alloy, in the melted state, on a marble slab, and breaking it as soon as solid, and when it may be readily handled, the exposed surfaces were found to exhibit a bright, smooth, or conchoidal metallic appearance, of a tin-white lustre; and the act of disjunction, at one part, will frequently cause the whole to fly into a number of fragments, analogous to the breaking a piece of unannealed glass.

The metal after this becomes so hot as to burn the fingers if taken up, and when this evolution of heat has ceased, the alloy will be found to have entirely altered its characters, having lost its extreme brittleness, requiring to be bent to and fro several times before it will break, and presenting, on fracture, a fine granular, or crystalline, surface, of a dark color, and dull, earthy aspect. Similar phenomena accompany the casting of the fusible alloy of H. Rose, composed of 2 parts of bismuth, 1 of lead, and 1 of tin.

The fact of the evolution of heat from the alloy of Newton, and its cause, are thus noticed by Berzelius, in his *Traité de Chimie.* "If this alloy is plunged into cold water, and quickly withdrawn, and taken in the hand, it becomes sufficiently hot, after a few moments, to burn the fingers. The cause of this phenomenon is, that during the solidification and crystalization of the *internal parts*, the latent heat of these is set free, and communicates itself to the surface before the fixing and cooling." The alteration in the internal arrangement of the particles, as proved by the surfaces of fracture, is not, however, noticed, and the explanation is defective, as it supposes the interior not to have assumed the solid state, until the evolution of the heat

occurs. If such were the case it would be seen on breaking it in the first instance. The phenomena can only be accounted for by admitting a certain degree of mobility among the particles, and that a second molecular arrangement takes place after the metal has solidified; this may arise from their not having assumed, in the first state, that direction in which their cohesion was the strongest.

That a very marked and extraordinary alteration in the characters and properties of various substances, arises entirely from this change in the position of their component particles, effected either by the communication, or abstraction, of heat after solidification, there can be no doubt. And these changes are applied to many very important purposes in the arts and manufactures; such as the hardening and tempering of steel, the rolling of commercial zinc, and rendering that metal permanently malleable, the annealing of glass, and a variety of other uses, particularly in crystalization, which might be adduced.

The following experiments were made to ascertain to what extent the emission of latent heat takes place. The melted alloy was poured in a perfectly fluid state on the bulb of a thermometer placed in a small platinum crucible, having a capacity equal to about 70 grain measures of water, and standing in a vessel of cold water, or mercury. The thermometer, surrounded by the solidified metal and crucible, was removed from the cooling medium before it had reached its stationary point, and the greatest decrease of temperature noted. The heat then rose rapidly again, and the maximum effect was registered. The fusing point of the alloy was 202° Fahr.; the following results were obtained:—

Exper.			Fahr.			Fahr.	Diff. Fahr.
1,	thermometer	fell to	97°	and then	rose to	157°	60°
2,	"	"	94	"	"	149	55
3,	"	"	90	"	"	150	60
4,	"	"	87	"	"	147	60
5,	"	"	104	"	"	156	52
6,	"	"	97	"	"	148	51
7,	"	"	92	"	"	152	60
8,	"	"	104	"	"	155	51

So that in four, out of the eight, trials a difference of 60° Fahr. was rendered apparent.

In a platinum crucible of larger size, the effects were not so marked, 34° Fahr. being the greatest difference obtained; this, of course, would arise from the greater bulk of the melted metal not exposing comparatively so large a surface to the cooling medium.

Mem. Chem. Soc., Lond.

On the conversion of Benzoic Acid into Hippuric Acid, in the Animal Economy. By Mr. Alfred Baring Garrod, *of University College.*

A paper has appeared in the Medico-Chirurgical Transactions for last year, and also in the first number of the Pharmaceutical Trans-

actions, by Dr. Alexander Ure, in which it is stated, that by the internal administration of benzoic acid, or any of its salts, hippuric acid is formed in the system, and is eliminated from the kidneys in the form of a soluble hippurate, and that this hippurate is formed by the benzoic acid uniting with uric acid. It is also stated, that no trace of uric acid, or any of its salts, could be found in the urine after the administration of the benzoic acid.

I have repeatedly performed Dr. Alex. Ure's experiment, swallowing from a scruple to half a drachm of benzoic acid at a time, and have always obtained a copious crop of crystals of hippuric acid, amounting to from fifteen to twenty-nine grains, by the addition of hydrochloric acid to the urine, passed about three, or four, hours afterwards, (evaporated, or not, according to its state of dilution.) These crystals possessed all the characters of hippuric acid, with the crystaline form, the small solubility in cold water and ether, the ready solubility in alcohol, the evolution of nitrogen, and also the odor of the tonquin bean when heated to destruction; and my experiments, therefore, so far confirm Dr. A. Ure's fundamental observation. He also mentions another test of hippuric acid, viz., that when evaporated to dryness with dilute nitric acid, and ammonia added, a beautiful purple color is produced. This is certainly true of the crystals obtained from the urine, but it is not a character of pure hippuric acid. The cause of this color will be shown presently.

Dr. A. Ure states that no trace of uric acid could be found in the urine; but on examination I have always been able to obtain a distinct trace of uric acid from a drop or two of the urine, by adding a little nitric acid, carefully evaporating, and holding the capsule containing it over ammonia, when a distinct trace of murexide was formed; also, when the dish containing the crystals of hippuric acid is carefully examined, minute grains are found at the bottom, which are uric acid crystals; and on examining the crystals of hippuric acid with the microscope, uric acid crystals are found adhering to them in immense numbers, and this is the cause of the production of the purple color spoken of, and which has been given as a test of hippuric acid. When the crystals are dissolved in alcohol the uric acid is precipitated, and the hippuric acid crystalized from the alcoholic solution no longer gives the purple color. On collecting the uric acid from the same quantity of urine, formed on successive days, the same food being taken, one containing about twenty-seven grains of hippuric acid, and the other none, the following results were obtained:—

From 4½ oz. of urine, when no benzoic acid had been taken, uric acid 1.07 grain.

From 4½ oz. of urine, after taking 30 grains of benzoic acid, uric acid 0.96 grain.

Difference in favor of first 0.11 grain.

In the second experiment also, a small loss might have occurred from the greater washing of the crystals necessary in that experiment. Now if we suppose that uric acid is decomposed to afford the elements necessary to be added to benzoic acid to form hippuric acid, we find that each equivalent of benzoic acid requires the addition of

$C_4 H_5 O_4 N$. To obtain the nitrogen, four atoms of benzoic acid would require one atom of uric acid, or half a drachm of benzoic acid would require rather more than ten grains of uric acid. Now the quantity of urine, in the experiment without the benzoic acid, only contained 1.07 grain of uric acid, and yet that quantity was not materially diminished when twenty-eight grains of hippuric acid were found in the urine. It cannot, therefore, be from the uric acid that the hippuric acid is formed.

If we examine the subject theoretically, it does not seem probable that such a body as benzoic acid, possessing such feeble affinities, and producing no sensible action on the body when taken, should be able to break up such a stable compound as uric acid; to abstract from the latter the requisite elements for its conversion into hippuric acid: but as hippuric acid is really formed in the urine, from whence does it obtain the necessary addition? The quantity of urea was noticed in several experiments to be deficient; could this be the source? We can find no rational formula for the explanation of the conversion, if we suppose it to be from urea alone. We can, it is true, select the elements required; but, as in the last case, we should leave some compound in the system, which cannot be resolved into any known compounds, as ammonia, water, carbonic acid, &c., while from the ready conversion of the benzoic acid into hippuric acid we should expect that the change was one which could easily take place, without the action of any unusual affinities being brought into play. It occurred to me that it might be the lactate of urea, instead of pure urea, which is taken up; and upon comparing the formula for hippuric acid, benzoic acid, and the lactate of urea, it appeared that one equivalent of lactate of urea minus three eqs. of water, gave exactly the requisite elements for the conversion of 2 eqs. of benzoic acid into 2 eqs. of hippuric acid. 2 eqs. of benzoic acid + 1 eq. of lactate of urea = 2 eqs. of hippuric acid + 3 eqs. of water.

Hippuric acid, (anhydrous)	$C_{18} H_8 O_5 N_1$,
Benzoic acid, (Do.)	$C_{14} H_5 O_3$,
Difference, . . .	$C_4 H_3 O_2 N_1$,
Twice the difference, . .	$C_8 H_6 O_4 N_2$,
Lactic acid, ...	$C_6 H_5 O_5$,
Urea, ...	$C_2 H_4 O_2 N$,
Lactate of urea, . . .	$C_8 H_9 O_7 N_2$,
Lactate of urea, $-3 H O =$	$C_8 H_6 O_4 N_2$.

Now the urea has, by MM. Cap and Henry, been found to exist in human urine as lactate, and the separation of the elements of water is a change which might be expected to take place in the system under such circumstances. The benzoic acid merely taking up the lactate of urea, and throwing off water, is certainly a more probable occurrence, than the destruction of such a stable compound as uric acid.

In analyses for the quantity of lactate of urea, according to the method of Cap and Henry, I found that although I could not obtain it in crystals, yet the quantity in a siropy state was much reduced

after taking the benzoic acid, and the same appeared on forming nitrate of urea from it. I obtained 14 grains less of urea in 4½ ozs. of urine when the benzoic acid had been taken. In another experiment I obtained 17 grs. less of urea when 30 grs. of benzoic acid had been taken; this is a greater loss than can be accounted for by the formation of the hippuric acid; but this can be referred to the urine, from some accidental circumstance, being of nearly as high specific gravity, in this case, as when the benzoic acid had been taken. 30 grs. of benzoic acid, swallowed, usually increased the specific gravity of the urine from four to six-thousandths.

From these results two inquiries suggest themselves:—1st, may not hippuric acid be formed artificially out of the body? 2nd, if sufficient benzoic acid were swallowed at such a time when the least urea was contained in the urine, would the benzoic acid not cease to be all converted into hippuric acid, part of it then appearing in the urine unchanged? Ibid.

Iron Founding.—From the Glasgow Practical Mechanic and Engineer's Magazine.

(Continued from page 196.)

Section IV.—Loam-Moulding.

Loam-moulding, the last branch of the art, as it has been treated in these papers, falls to be discussed in the present article. As already described, the peculiar functions of the loam-moulder is to construct loam patterns and mouldings of certain cast-iron work, by which the mould may be formed without incurring the expense of the construction of a wood pattern for that purpose. In many cases, also, the loam-moulder constructs moulds for which wood patterns could not be provided. The economical employment, however, of loam as a substitute for wood patterns and sand, is restricted, in general, to the manufacture of the more regularly shaped work of a foundry. Every variety of circular bodies may be done in loam: large square vessels, too, are done by the same process.

Every piece of loam-moulding, of any considerable extent, is a regularly built structure, being composed of bricks, arranged in layers, and bedded in loam, in which they are also entirely enveloped, particularly on those sides contiguous to the mould. The composition of loam demands strict attention, varied, as it requires to be, suitably to the various applications of loam. Two indispensable qualities are those of firmness and porosity. The first is evidently necessary, considering the very great hydrostatic pressure to which, in large castings, mouldings are subjected, while the iron is liquid. And again, the copious effusion of gases from the mould, arising from the action of the heat of the cast, renders it absolutely necessary to provide for their escape through the material of the mould. This is provided for in the porosity of the mass, which must, therefore, be in such a degree as to offer a transit sufficiently free to the airs evolved, while the mould

is impervious to the metallic fluid. To fulfil these conditions, the materials of loam are principally clay, and clean sharp sand. These elements are opposed in their nature, and operate as counteractives. The clay is the binding element, from which the loam derives its firmness: the sand, intermixed with it, modulates its closeness, and renders the loam open in the grain. Thus, both these elements are essential in the composition of the substance. Cow hair, also, obtained from hides of cattle by tanning, is mixed in loam: it answers two purposes. In the first instance, while the raw loam is being moulded into the form desired, the hair assists the tenacity of the parts of the loam, which is often largely charged with water. Again, when loam work is baked in the stove, which, for cores, is raised to the greatest attainable temperature, the hair is burnt out of the loam, and, of course, leaves its own empty track. The mould is thus perforated in all directions, throughout, by these artificial sinuosities; and in this way the openness of the mould is very much increased. Mill-seeds, sawdust, horse-dung, and straw, especially the last, are also extensively used in the formation of loam cores. It ought to be understood that loam cores must be completely dried and burnt before they can be serviceable; the object being to anticipate the work of the hot iron, with which they must afterwards come in contact, by expelling completely their humidity, and the occasional gases originated by the burning of their combustible matter. Were this precaution not taken, particularly for cores much confined, they would inevitably be broken up by the sudden generation of confined air, which could not escape as suddenly. It may be as well to state here, that the general results of the action of melted iron on the mould are carbonic acid and oxide, and carburetted hydrogen. In the first place, the carbon constituting the blackening used in all moulds, and the coal powder in green sand moulds, seizes and combines with the oxygen of the aqueous particles in the neighborhood, forming a mixture of carbonic acid and oxide; the hydrogen of the water thus let loose, combines with another portion of carbon, producing carburetted hydrogen, which, with the carbonic oxide, burns with a bluish yellow flame on coming in contact with the external atmosphere.

For all varieties of circular bodies, or such as may be described round one axis, a wooden board is cut on one edge to the exact form of the object, being, in fact, a half skeleton of its outline. If the body be cored out, a board must also be provided, cut to the form of the interior space. A central spindle is erected, which is to represent the centre of the body to be moulded; to this spindle one, or more, arms are screwed, provided with glands, by which the *loam board*, as it is termed, is set at the proper radial distance from the centre, and firmly fixed to it. The whole being in this condition turned round the centre, it is obvious that the figure of the body will be described. With this general idea, we shall proceed to particular description.

Sugar pans are among the most familiar examples of loam casts, and, as they are in themselves instructive specimens of this kind of work, they shall be selected as our first illustration.

Fig. 1, Plate I, is a general view of a Carron shaped sugar pan.

The portion *a b*, constituting the pan, is a simple spherical cone, and *b c*, is the brim.

The pan is moulded and cast in an inverted position, similarly to the Irish pots already described. In the first place, then, a cast-iron ring, *a a*, fig. 6, Plate I, is leveled upon blocks, which raise it off the floor of the foundry, and is placed concentric with a spindle, *b*, which stands upright, being placed at the under end in a cast-iron step sunk in the floor, and stayed at the upper end in a bush on the end of a bracket, *c*, which projects from the wall, and turns horizontally upon pivots. The spindle thus stayed is free to move round in both directions. To prevent the bracket from moving on its pivots, it is linked by the extremity to the wall. A forked arm, *d*, is fixed upon the spindle by an eye at one end, tightened by a pinching screw. Between the branches of this arm the loam board, *e*, is set, and fixed by glands in the required position.

Fig. 2, represents the outlines to which the loam boards are cut; *a b c*, is the figure of the interior surface of the pan, *b d*, being the axis. A board, *e*, is, in the first place, cut to the semi-outline of the interior; and, further, has an additional check, *o*, which turns out a corresponding knee in the mould, the object of which is to support the overlying part of the mould on its horizontal surface, and to act afterwards, by its vertical surface, as a guide in replacing the mould. Another board, *f*, is in the same way cut to the external figure of the pan, with a check precisely similar to the one in the board, *e*; and thus it will act as a guide in setting the second board.

Fig. 3, is a vertical section of the work in the first stage of its progress. Upon the ring, *a a*, a kind of dome, *b b*, is, in the first place, built of bricks and loam, generally four inches thick. The moulder is guided in the construction of this dome by the interior loam board, sustained by the spindle. The external surface ought to be everywhere about two inches distant from the surface described by the board, *e e*. Before building up the dome to the crown, coals are placed on the floor within it, which are afterwards kindled for drying the work. The crown is then nearly completed, leaving only a small space round the spindle to allow of ventilation, when the combustion within is going on. By this aperture the moulder is enabled to manage his fire so as to check its progress if necessary. The consumption ought to be very slow, so as to allow of the heat taking effect upon the entire mass.

Over the brick dome a pasty layer of core loam, *c c*, is applied; for it is, in fact, the core that is now being formed. The surface is finished off by a smooth coating of wet loam, the redundancies all over the surface being swept off by the board in its revolution. Upon this surface the inside of the sugar pan is cast. The fire is now kindled, and, as the surface of the mould becomes dry, it is painted over by a brush with a mixture of water and charcoal powder, with a little clay additional. This operation prevents adhesion between the surfaces of the core, and the coat of loam applied to it.

The core board having been removed, it is replaced, as in fig. 4, by the thickness board, *f*, fig. 2, of which the edge describes the externa.

surface of the pan, and, as already remarked, simply rubs against the knee formed round the base of the core. Another layer of loam, *a a*, is then spread over the core, and is rounded off properly by the board similarly to the core itself. This "thickness," it is evident, is the exact model of the pan itself. When well dried, it is blackwashed as was done to the core. The upright spindle is now removed, leaving the small vent-hole through which it passed to promote the complete combustion of the coal. There is now laid horizontally upon the ears of the platform, *d d*, fig. 4, another similar platform like the former, but sufficiently large to pass over the moulding already executed. A new layer of loam, two inches thick, is laid over the thickness, and smoothed by hand. Then, upon the second platform, a brick vault is constructed as before, of which the inner surface applies to the new coat of loam. This contracts a strong adherence with the bricks, which absorb a part of its moisture, while the coat of paint prevents its adhesion to the thickness. The brick and loam covering are named the cope.

The structure is now completed so far as the formation of it is concerned. The whole mass must now be thoroughly baked by the continuance of the fire. Stoves are preferred to internal fires, when they are large enough to receive the work. The intense heat, however, necessary to the preparation of many cores placed in confined parts of moulds, is not essential to such cores as the above described, where there is so free space within it for the escape of air.

Cast-iron bars may be substituted for the brick forming the cope. These "irons" must, of course, have the curved form of the dome to which they apply, being arranged so as to converge towards the crown. They are simply run off in open sand, when required, with snugs cast upon them, by which the cope may be lifted off. They are bedded in the external coat of loam, which is smoothed over them, and bound together by wires and bands of hoop-iron.

The next step is to lift off the cope, which is done with the assistance of a crane. This being done, access is had to the interior, and the thickness is easily broken away without any injury to the mould; this thickness being, in fact, the pattern of the pan, it is evident that when the cope is replaced exactly, which may be done by the guidance of the knee before described, there will be a space within to be filled by metal, being the true form of the pan. Before replacing the cope, the vent aperture in the core is filled up and smoothed over, though the one in the cope is left open to serve afterwards as a gate for the reception of the metal.

The cope being reset and clamped firmly to the core by double knees and wedges embracing the rings, the whole is removed to the pit in which it is sunk, and rammed up tightly with sand by iron rammers, which are managed by half a dozen, or more, men, who walk regularly round the moulds, keeping time with their rammers, and dealing heavy and light blows alternately, while one or two workmen above shovel in additional sand as required. Fig. 5, is a vertical section of the pit, showing the manner in which it is arranged. A space sufficiently deep is first cleared out, and across the bottom a

passage, *a a*, is cut and overlaid with plates, having only an open part at the centre, which connects it with the interior space, *b*, in the mould. Two pipes, *c d*, *c d*, are next laid in against the sides of the pit, communicating with the channel, *a a*. When the mould is lowered into its position in the centre as indicated, and the sand rammed about it in the way already described, an oblong, shallow trough-like cavity, *e*, is formed in the surface of the sand, one end of which opens into the gate hole of the mould, which is closed by a pin while the ramming is proceeded with.

The channel, *a a*, and the pipes, fulfil the very important purpose of venting the air confined in the hollow space, *b*, together with what is forced through the substance of the core when the metal is poured. Now, as a large quantity of inflammable gas is driven off, its union with the atmospheric air in the chambers below, forms a dangerous explosive mixture, which, rushing out at the openings, *d d*, might be inflamed by accident, and if not prevented would blow up the whole work with irresistible force. To prevent such an occurrence, the vents are stopped at *d d*, with plugs of straw, or mill waste, or simply covered with pieces of fine wire sieve; the gas passing through these substances before being exposed to accidental inflammation, security from explosion is rendered certain, as flame cannot pass through their interstices. The principle alluded to is familiar to all, as exemplified in the Davy lamp, in which the flame in the interior is intercepted by a wire gauze medium.

When the metal has been poured, and has well set, the casting is cleared out as quickly as possible, as, on account of the contraction it undergoes, it is apt to jam upon the core. Confined cores are always broken up as soon after casting as may be, especially when their form is calculated to resist great compressive force.

When the object to be moulded presents more complicated forms than the one now chosen, for the sake of illustration, it is always by analogous processes that the workman constructs his loam-moulds, but his sagacity must hit upon modes of executing many things which at first sight appear to be scarcely possible. Thus when the forms of the interior and exterior do not permit the moulds to be separated in two pieces, it is divided into several, which are nicely fitted with adjusting pins. More than two cast-iron rings, or platforms, are sometimes necessary. When ovals, or angular, surfaces are to be traced instead of those of revolution, no upright spindle is employed, but wooden, or cast-iron, guides, made on purpose, along which the pattern cut-out board is slid, according to the drawing of the piece. In addition to brick work, iron wires, or claws, are often interspersed through the work to increase its adhesion. When parts of a mould are higher than that portion immediately under the gate, flow-gates are usually adapted to such parts, by which they may be relieved of the impurities that would be apt to lodge there. Such a case is that of a flattish bottomed boiler, of which the bottom is hollow externally.

Our second example of loam-mouldings shall be that of the steam cylinder of an ordinary high pressure engine. Fig. 7, Plate I, is a

side elevation of one; fig. 8, is a sectional elevation; fig. 9, represents a horizontal section taken through the centre of the exhaust steam passage; *a a*, are the steam passages to the cylinder; *b b*, the exhaust passage, all uniting in the face *c*; *d*, is the outlet from the passage *b b*.

It is to be noted that the body of the cylinder is round, while the base, or bottom, flanch *e e*, is square, and the face *f c f*, containing the steam ways, is supplementary to the main part, as also the stiffening feathers for strengthening the base. For these parts, then, patterns in wood are made adapted to fit the loam work. Fig. 10, is front and side views of the pattern of the part *f f*, having core prints *c c c*, for the usual purpose of steadying the cores.

As the upper flanch of a cylinder, such as the one now described, is generally smaller than the under one, and more exposed to view, the cylinder is usually cast in an inverted position, to have the former flanch solid. According to the method now most generally adopted for moulding cylinders, the cope, or external outline, is formed, in the first place, by an interior loam board cut to the form on the outer edge. Thus, the cope is first constructed, after which it is removed, and, on the same centre, the core, or interior outline, is formed by an external loam board cut on the inner edge. If now the cope be replaced concentric with the core, they will include between them a vacant space, being the exact figure of the cylinder. Fig. 11, represents the two first stages of the work; the core ring *a a*, seen in section, being of the dimensions necessary for the work, is first laid down concentric with the spindle *b*, and leveled off the ground upon blocks. To the arm *c*, projecting from the spindle, the loam board *d*, is fixed by glands embracing two arms nailed upon it. This board is cut to form the bearing *e*, of brick and loam for the core, the bearing acting also by its sloping edge as a guard in closing the mould.

Its upper surface now forms the lower side of the cylinder flanch. The board is now altered as expressed at *f*, on the opposite side, so as to form the flanch *i*, which is made simply of loam. This is the second stage of the work, and the flanch must be dried like the bearing before it, to prepare for the next stage. It is necessary to form the flanch singly, to be an additional bearing upon which the superstructure is founded. If it were cut at once out of the cope, the overhanging loam must give way.

The arm *c*, is now shifted up along the spindle sufficiently high for the next operation, represented at fig. 12. A loam board *d*, is cut to the form of that part of the cylinder included between the extreme flanches—these themselves, as we have stated, being made of loam and wood. The board includes the exterior outline of the circular exhaust passage; and it will be seen that, when set in motion, it touches the flanch at the bottom, and a horizontal piece *b*, projects from it to the top to sweep a flat surface on the cope, upon which the square flanch is to be laid. The arm *c*, is assisted in holding the board by two pieces of iron *f*, at the bottom, screwed together upon the spindle and the board, the cope ring *h*, having been laid down upon the core ring *a a*, surrounding the bearing *e*, with a little space

between them. The steam way pattern, fig. 10 is set in its place in an inverted position, resting on the flanch *i*. Its precise position will be ascertained by the loam board, which ought to touch it when passed round. The building is commenced upon the cope ring; and, having been raised above the flanch *i*, another ring *k*, is bedded on the building, lying near into the loam board, with a segment cut out of it sufficient to clear the steam way pattern on both sides. Upon this ring the building is continued till near the under side of the exhaust passage, at which place a similar ring *l*, is bedded on the structure, overhanging it sufficiently to sustain the building round the passage, at which place it is greater in diameter. Having built up the height of the passage indicated by the board, a layer of loam on the top is swept flush with the upper side of the projection by means of a transverse stick nailed on the board. This forms a parting surface, by which the cope is divided into two parts, the necessity of which is apparent on considering the method of placing the cores for the exhaust passage. After blackwashing the surface, a third ring *m*, with projecting snugs on its rim, is laid over it, being faced, however, with a layer of loam to protect it from the melted iron. The building is continued upon this plate till it reaches the top, when it is succeeded by another plate *n*, of a square external form, and somewhat larger than the square base plate of the casting immediately over it. The building is finally carried up to the horizontal piece *b*, which smooths off the upper surface with loam.

It will be remembered that the mould is on one side, cut longitudinally throughout, by the pattern of the steam ways. On that side, therefore, it has to be completed; this object is attained by providing a cast-iron plate, done in open sand, fitting generally the interior of the pattern, and having three openings through which the core prints are passed when the plate is applied. It is daubed all over the inner face with stiff loam, and being set up in its place, the loam receives the impression of the face of the pattern. Lastly, the square flanch pattern is laid over the whole, upon the bed prepared for it; preceded by the four stiffening flanches, and is surrounded with additional loam, flush with its upper side, to form a bearing for the top plate.

In the manner thus described, the external figure of the cylinder is formed. The whole mould from the bottom is lifted by the snugs on the cope ring *h*, off the core ring, upon which the two layers *e* and *i*, are left. It is conveyed to a sufficient stove to be thoroughly dried.

This is an operation comparatively simple, as the core is but a simple cylinder of brick and loam. In the first place, as the loam flanch *i*, has formed its impression on the interior mould under the plate *k*, it is of no further use, and is, therefore, broken away, leaving the bearing clean to receive the core, as represented on the left side of fig. 12; *o*, is the loam board in its proper position for working, having its inner edge set parallel to the spindle, and to the diameter of the cylinder required, and simply fixed to the arm at the top. A cylinder of brick work *p*, is first built up, being every where an inch or so clear of the board. A coat of loam *s*, is next laid on as usual,

to fill up the clearance, and complete the core. The board and the spindle being removed, the work is lifted away to the stove on the core ring *a a*, by the snugs upon its rim.

The next business of the moulder is the formation of the smaller cores, which are to form the winding steam passages to the cylinder, of which there are three; the two supply passages *a a*, and the exhaust passage *b*. The two former being of the same shape, may be formed from one core box, seen in plan and section at fig. 6, in which *a*, indicates the core boxes; for such kinds of cores are usually formed on three sides, and open on the fourth side to admit the material, which is shaped off on this side by the edge of a piece of wood cut to the contour of the core, and drawn along upon the sides of the core box as guides. The core for the exhausting way is partly circular, and partly otherwise at the ends. Its formation is thus more complicated than that of the other cores. It is made in three parts; the centre part annular to embrace the cylinder, and formed by a loam board, and the terminations made in core boxes, and fitted to the other: fig. 14, is a vertical view of the method of making the annular core. It is built upon a portable square table, convenient for small, circular work generally, as it may be conveyed to the stove without the necessity of shifting the centre. The spindle turns by a conical pivot on its under end moving in a socket, which is the only staying it requires. A block *a a*, is first prepared, being a plain built ring of which the exterior is smoothed with loam, and is made exactly to the interior diameter of the core, and to the same depth. The core seen in section at *b*, is run upon the outside of the block to the necessary thickness, in the course of which two wrought-iron angular rods are imbedded in the core to impart their stiffness to it. At *b'*, is shown the valve face portion of the core, (at *c*, fig. 8,) of which *c*, is the box for making it in section. The round core for the short, straight passage *d*, fig. 16, is made of loam, being run up on a short iron centre.

In the making of these small cores, as in that of green sand, it is necessary that they be strengthened with iron rods bent to their form, so as to pass through the heart of them, and finished with eyes at the outer extremities, for locking them to the face plate. An open passage, running through each core, is formed, as in green sand cores, by laying pieces of cord along the irons. These passages are of great importance, as, upon them depends the escape through the openings in the face plate, of the otherwise confined air existing in the mould, while the metal is being run. The too close proximity of these passages at any point to the surface of the cores must be well guarded against. In such a case, the melted metal in contact with the core breaks into the interior of it, and intercepts the air in its escape, which aggravates the evil, by forcing it into the body of the metal, and thus rendering the casting unsolid. The accident even assumes, in some cases, a more serious aspect, by causing such an agitation in the metal as to render the cast utterly useless; indeed, we have even seen the metal already poured almost wholly expelled from the mould, and sent in showers through the foundry, the occurrence being entirely attributable to an oversight of the nature referred to.

Fig. 15, is a side view, in section, of the mode of placing and fixing the cores *a a*, for the steam ways to the cylinder; *q q*, is the face plate lined with stiff loam, which retains the impression of the steam way pattern; *a a*, are the two cores, the nearer ends of which are passed through the openings made in the plate for them, and fixed there by small rods passed through the eyes of the stiffening irons. The ends are made with shoulders which bear upon the upper side of the plate, fig. 15, which may be understood from the form of the prints in fig. 10. The horizontal parts of the cores *a a*, fig. 15, are supported at their proper distance off the loam work beneath them, by steeples stuck into it.

The mould and the cores having been well dried, they are dressed and smoothed where necessary, and finished with a coat of coal powder. Fig. 16, is a vertical section of the whole mould, showing all the parts fitted to one another, so as to contain among themselves the vacant space indicated by a white ground, into which the metal is delivered. The mode of depositing and putting together the mould is as follows: the main core *p p*, is lowered upon its rings, from which it is never separated, into a pit dug in the floor of the foundry sufficiently deep to receive the core below the surface. The exhaust passage core is next deposited in its exact position in its place on the top of the lower part of the cope, being sustained in the usual manner off the core by chaplets made of two pieces of strong hoop iron, riveted on the ends of two studs, so as to have the necessary thickness of space. The lower part of the cope, thus furnished, is next lowered over the main core into its place upon the core ring, thus surrounding the core, and containing within it a space between, as indicated in the figure. Another set of chaplets are deposited upon the exhaust core, which, by being in contact with the upper half of the cope when placed above, prevent the core from floating off its seat when immersed in the fluid metal. This is a matter of greater moment than the sustaining of the core from below, as will be apparent on considering the great difference of specific gravities of dry loam and iron. In this case the upward effective pressure of the fluid metal upon the core, is proportional to the difference of their specific gravities, which being so much in favor of iron, the pressure upwards, sustained by the chaplets, cannot be much less than the weight of a body of iron of the same bulk as the core. Therefore, as a safe general rule, chaplets are, or ought, to be made of sufficient strength to resist the weight of a body of iron equal in bulk to the core, for the support of which they are destined.

The upper part of the cope having been let down into its place, the face plate with its cores fixed to it, fig. 15, is let down in front of the vacancy in the side of the cope, till it arrive at the proper height, when it is set close into its place, and the end of the exhaust core *b*, receives *d*, through the middle opening in the plate, and secured on the outside by the eye. The branch core *d*, is then set in, and supported on chaplets, and over it a ring, or cake, of loam *m l*, seen in section in the figure, is placed, being strengthened internally with

Fig. 1.

Fig. 2.

Fig. 16.

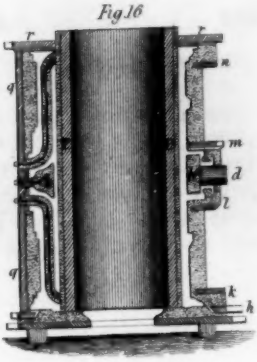


Fig. 3.

Fig. 4.

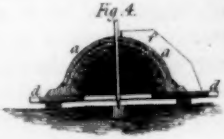


Fig. 5.

Fig. 12.

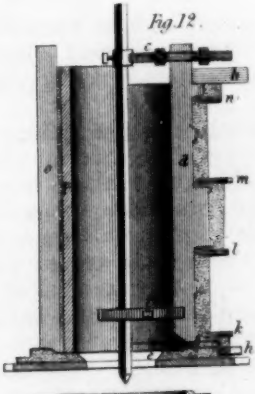


Fig. 6.

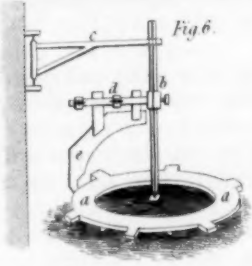


Fig. 10.

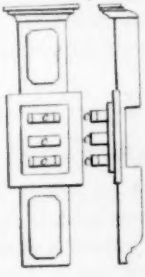


Fig. 13.

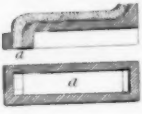


Fig. 14.

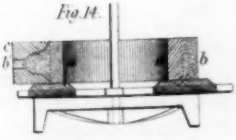


Fig. 8.

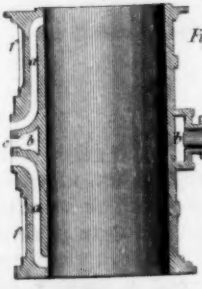


Fig. 9.

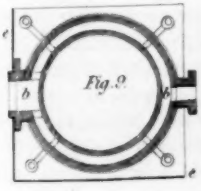


Fig. 11.

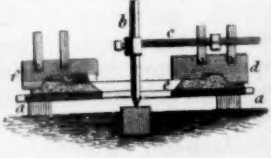


Fig. 7.

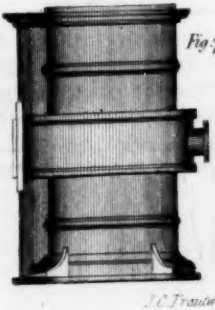
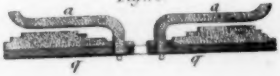


Fig. 15.



Engraved by J. Yeager.

J.C. Trautwine Del.

iron, like the cores. Thus the cake of loam forms, by its inner surface, the outer surface of the flanch.

The mould being all finished below the top, the pit sand is rammed tightly round it, to enable it to withstand the pressure of the metal, air vents being provided in a manner similar to those for the sugar pan mould already described. The top plate *r r*, is laid on lastly, holes being provided in it for the admission of the metal. It is covered in with sand, through which passages are led up to form the holes to the external surface as runners.

To be Continued.

Extraction of Palladium in Brazil.

The extraction of palladium, from the auriferous sand of Brazil, consists in fusing it with silver, and, consequently, forming a quaternary alloy of gold, palladium, silver, and copper, which is granulated by projecting it into water.

By treating this alloy with nitric acid, the gold is separated from the other metals which are soluble in the acid; the silver is precipitated by a solution of common salt in the state of insoluble chloride, which being separated, the copper and palladium are precipitated by plates of zinc. The pulverulent deposit of these metals is redissolved in nitric acid, and the solution precipitated by excess of ammonia, which redissolves the oxide of copper and of palladium. When the ammoniacal solution of these metals is saturated with hydrochloric acid, a double chloride of palladium and ammonia is deposited in the state of a crystaline yellow powder, and this, when calcined in a crucible, is readily decomposed, and leaves spongy palladium.

Philos. Magazine.

On the Daguerréotype Art.

The secretary next read a paper, by Mr. Claudet, "On the Daguerréotype Art," including a complete history of its origin and progress; one of Mr. Claudet's assistants showing, by means of artificial light, the whole process of producing a picture. The most important part of this communication related to an improvement lately applied; it is a process of engraving on a metallic plate. M. Fizeau is the discoverer of this new mode of engraving. Professor Grove has tried the process, which consists in dissolving, by the electrotype process, those parts of the picture which consist of pure silver. Thus the plate is etched in, and transformed into an engraved plate for printing; the action, however, of the galvanic battery sometimes extends to those parts which should remain unattacked.—*Trans. Soc. Arts.*

Civ. Eng. and Arch. Jour.

Meteorological Journal for 1845, *kept at the Lancaster Conservatory of Arts and Sciences, Lancaster, Pa., by* WASH. L. ATTLEE, M. D., *Obs.*

		Barometer.			External Thermometer.					Hygrom'r, 2 P.M.			Sky.				Winds.				Clouds.			R'in.
		7A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r	Mean	Dew point.	Diff. dw pt &tem	Wet bulb.		7 A.M. Days.	2 P.M. Days.	9 P.M. Days.		7A.M. Days.	2P.M. D'ys.	9P.M D'ya.	7A.M. D'ys.	2P.M. D'ys.	9P.M. D'ys.	G'ge. Incs.
January.	Att. ther.	36.94	43.92	39.66													N.	2	2	3	0	0	0	
																	N.W.	9	12	12	9	6	1	
																	N.E.	1	1	4	0	1	0	
	Average	29.52	29.46	29.50	30.97	42.55	33.60	29.71	35.71	30.87	9 93	38.95	Ent. clr.	7	8	15	S.	1	3	0	1	1	0	
	Maximum	30.06	30.06	30.12	53.00	58.00	49.50	47.00	51.75	56.50	18.24	56.50	Ent. cld.	10	9	10	S.W.	5	4	1	1	3	0	
	Minimum	28.75	28.53	28.78	3.00	20.00	10.00	2.00	14.00	8.56	0.00	18.00	Part. clr.	14	13	6	S.E.	7	7	7	0	0	1	
	Range	1.31	1.53	1.34	50.00	38.00	39.50	45.00	37.75	47.94	18.24	38.50					W.	3	1	2	5	6	0	
																	E.	3	0	2	1	0	0	
Omitted		0	1	0	0	1	0	0	1	1	1	1		0	1	0		0	1	0	7	5	14	2.260
February.	Att. ther.	27.56	33.58	29.52													N.	1	2	1	0	0	0	
																	N.W.	8	10	10	8	6	3	
																	N.E.	4	2	3	0	0	0	
	Average	29.36	29.34	29.39	22.32	31.52	24.26	22.78	25.88	16.04	15.75	27.65	Ent. clr.	5	4	7	S.	2	2	1	0	1	0	
	Maximum	29.77	29.77	29.85	36.00	48.00	37.00	31.00	38.25	36.00	30.90	40.00	Ent. cld.	9	9	9	S.W.	4	2	1	1	2	0	
	Minimum	28.86	28.84	28.86	8.00	18.00	9.00	6.00	14.25	-4.98	0.00	17.00	Part. clr.	12	11	9	S.E.	2	2	1	0	0	0	
	Range	.91	.93	.93	28.00	30.00	28.00	25.00	24.00	40.90	30.90	23.00					W.	3	4	6	4	3	2	
																	E.	2	0	2	0	0	0	
Omitted		1	4	3	0	3	3	0	3	4	4	4		2	4	3		2	4	3	8	8	13	2.272
March.	Att. ther.	20.08	36.79	32.48													N.	1	3	1	0	0	0	
																	N.W.	15	12	10	3	7	1	
																	N.E.	4	2	4	0	0	0	
	Average	29.39	29.38	29.39	23.76	36.27	26.73	20.92	28.60	19.64	16.28	31.58	Ent. clr.	11	6	16	S.	0	0	0	0	0	0	
	Maximum	29.77	29.71	29.77	41.00	58.00	37.50	35.50	45.00	43.86	37.87	51.00	Ent. cld.	10	8	11	S.W.	1	3	3	1	2	0	
	Minimum	28.76	28.64	28.93	13.50	19.00	11.00	10.00	17.00	4.61	0.00	17.00	Part. clr.	10	17	4	S.E.	3	2	5	1	0	0	
	Range	1.01	1.17	.84	27.50	39.00	26.50	25.50	28.00	39.25	37.87	34.00					W.	4	6	6	6	8	1	
																	E.	3	3	2	0	0	0	
Omitted		0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0	9	8	13	4.475

		Barometer.			External Thermometer.					Hygrom'r, 2 P.M.			Sky.			Winds.				Clouds.			Rain.
		7 A.M	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r	Mean	Dew point.	Diff. dw pt. &tem	Wet bulb.		7 A.M Days	2 P.M Days	9 P.M Days		7 A.M Days	2 P.M Days	9 P.M Days	7 A.M Days	2 P.M Days	9 P.M Days	Rain Ga'ge. Inch.
April.	Att. ther.	49.75	60.05	52.30													N.	0	1	2	0	3	0	
																	N.W.	11	12	5	6	8	0	
																	N.E.	5	2	5	0	2	0	
	Average	29.45	29.44	29.44	45.85	57.73	47.65	42.40	50.07	40.63	17.10	49.92	Ent. clr.	7	2	12	S.	2	4	2	0	0	0	
	Maximum	29.74	29.71	29.68	60.00	77.50	60.00	57.00	64.25	67.00	44.54	67.00	Ent. cld.	14	11	12	S.W.	2	2	4	0	5	0	
	Minimum	29.81	28.96	28.97	28.50	38.00	31.00	28.00	34.25	8.46	0.00	34.00	Part. clr.	9	17	6	S.E.	3	4	8	1	4	0	
	Range	.93	.75	.71	31.50	39.50	29.00	29.00	30.00	58.54	44.54	33.00					W.	2	1	3	5	3	1	
																	E.	5	4	1	3	2	0	
Omitted		0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0	8	2	17	2.390
May.	Att. ther.	57.31	67.80	60.37													N.	2	1	2	0	2	1	
																	N.W.	9	8	6	5	5	1	
																	N.E.	3	2	2	0	0	0	
	Average	29.52	29.50	29.50	54.69	67.05	56.35	51.11	59.04	49.03	17.99	57.07	Ent. clr.	5	4	6	S.	4	2	3	1	1	0	
	Maximum	29.83	29.84	29.80	67.00	85.00	71.00	64.50	74.75	65.55	32.19	71.50	Ent. cld.	12	7	12	S.W.	1	5	3	4	5	0	
	Minimum	29.25	29.27	29.18	42.50	50.50	43.00	38.00	46.50	36.28	0.00	47.00	Part. clr.	14	17	12	S.E.	4	4	9	2	1	0	
	Range	.58	.57	.62	24.50	34.50	28.00	26.50	28.25	29.27	32.19	24.50					W.	4	3	4	7	7	1	
																	E.	4	3	1	1	2	0	
Omitted		0	3	1	0	3	1	0	3	3	3	3		0	3	1		0	3	1	6	2	21	4.260
June.	Att. ther.	66.39	77.98	70.72													N.	1	1	1	0	2	0	
																	N.W.	8	4	5	1	3	0	
																	N.E.	1	0	2	0	0	0	
	Average	29.54	29.53	29.53	64.04	77.48	66.57	61.57	69.38	59.25	18.19	65.79	Ent. clr.	8	2	18	S.	4	7	6	0	3	0	
	Maximum	29.88	29.88	29.85	74.00	87.00	77.00	74.00	78.75	71.27	26.53	75.00	Ent. cld.	7	3	1	S.W.	6	9	6	5	9	0	
	Minimum	29.22	29.20	29.26	42.00	55.50	44.00	37.00	49.25	34.23	0.00	46.00	Part. clr.	13	24	11	S.E.	3	3	6	0	0	0	
	Range	.66	.68	.59	32.00	31.50	33.00	37.00	29.50	37.04	26.53	29.00					W.	3	5	3	2	12	3	
																	E.	2	0	0	0	2	0	
Omitted		2	1	0	2	1	0	0	1	1	1	1		2	1	0		2	1	1	6	0	9	2.000

Meteorological Journal—Continued.

		Barometer.			External Thermometer.					Hygrom'r, 2 P.M.			Sky.				Winds.			Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r	Mean	Dew point.	Diff. dw pt & tem	Wet bulb.		7 A.M	2 P.M	9 P.M		7 A.M	2 P.M	9 P.M	7 A.M	2 P.M	9 P.M	Rain Gauge. Inches.
																		Days	Days	Days	Days	Days	Days	
July.	Att. ther.	69.75	80.85	73.55													N.	6	2	2	0	3	0	
																	N.W	4	4	5	5	4	2	
																	N.E	3	2	6	0	0	0	
	Average	29.58	29.57	29.56	67.02	80.10	69.73	65.08	73.31	64.23	15.82	69.50	Ent. clr.	11	4	11	S.	2	2	2	0	2	0	
	Maximum	29.87	29.88	29.88	79.00	90.50	79.00	78.00	83.50	72.95	24.24	78.00	Ent. cld.	6	6	3	S.W.	4	9	6	1	3	0	
	Minimum	29.42	29.30	29.38	57.50	67.00	60.00	54.00	64.50	49.68	0.00	59.00	Part. clr.	13	20	17	S.E.	2	2	5	1	1	0	
	Range	.45	.58	.50	21.50	23.50	19.00	24.00	19.00	23.27	24.24	19.00					W.	6	6	4	9	12	3	
																	E.	3	3	1	0	0	0	
Omitted		1	1	0	1	1	0	0	2	1	1	1		1	1	0		1	1	0	4	2	15	4.450
August.	Att. ther.	70.50	78.76	73.03													N.	1	3	2	0	1	0	
																	N.W.	6	7	3	0	2	0	
																	N.E.	7	3	6	1	0	0	
	Average	29.62	29.62	29.62	67.78	77.54	69.38	66.32	71.94	67.25	11.58	70.13	Ent. clr.	7	0	9	S.	3	3	3	1	1	0	
	Maximum	29.86	29.87	29.87	75.00	83.00	75.50	75.00	78.75	75.00	20.92	75.00	Ent. cld.	8	6	8	S.W.	2	2	3	7	4	0	
	Minimum	29.43	29.42	29.36	60.00	67.00	65.00	58.50	65.00	56.08	0.00	64.00	Part. clr.	12	21	13	S.E.	4	5	9	0	2	0	
	Range	.43	.45	.41	15.00	16.00	10.50	16.50	13.75	18.92	20.92	11.00					W.	2	3	3	4	12	1	
																	E.	2	1	1	0	3	0	
Omitted		4	4	1	4	4	1	0	4	5	5	5		4	4	1		4	4	1	9	4	19	5.965
September.	Att. ther.	65.38	73.87	66.58													N.	6	3	5	0	1	0	
																	N.W.	3	3	2	4	5	1	
																	N.E.	3	3	2	1	1	0	
	Average	29.64	29.63	29.62	62.40	72.56	63.19	61.00	66.98	60.36	12.20	64.96	Ent. clr.	7	0	9	S.	1	4	0	0	1	0	
	Maximum	29.93	29.94	29.87	72.50	87.00	75.50	72.50	79.75	73.62	19 57	77.00	Ent. cld.	13	6	9	S.W.	5	4	2	1	4	0	
	Minimum	29.30	29.38	29.39	42.00	54.00	45.00	39.00	49.25	39.93	0.00	49.00	Part. clr.	5	18	6	S.E.	3	0	3	1	1	0	
	Range	.63	.56	.48	30.50	33.00	30.50	33.50	30.50	33.69	19.57	28.00					W.	2	5	5	2	7	1	
																	E.	2	2	5	0	1	0	
Omitted		5	6	6	5	6	6	0	6	6	6	6		5	6	6		5	6	6	10	3	13	6.840

		Barometer.			External Thermometer.					Hygrom'r, 2 P.M.			Sky.				Winds.			Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r	Mean	Dew point.	Diff. dw pt &tem	Wet bulb.		7 A.M Days	2 P.M Days	9 P.M Days		7 A.M Days	2 P.M Days	9 P.M Days	7 A.M Days	2 P.M Days	9 P.M Days	Rain Gauge. Inches.
October.	Att. ther.	48.81	58.29	51.38													N.	2	0	0	0	1	0	
																	N.W.	11	13	12	1	9	2	
																	N.E.	0	2	2	0	1	0	
	Average	29.47	29.52	29.55	45.03	56.81	47.36	44.73	50.02	43.40	13.23	50.43	Ent. clr.	16	2	8	S.	5	2	3	0	0	0	
	Maximum	29.83	29.87	29.89	59.50	72.00	65.00	59.00	65.50	66.00	25.25	66.00	Ent. cld.	8	7	9	S.W.	5	7	3	6	3	2	
	Minimum	29.09	29 09	29.18	32.00	43.50	31.00	30.00	36.75	28.59	0.00	38.00	Part. clr.	7	20	12	S.E.	4	2	2	0	0	0	
	Range	.74	.78	.71	27.50	28.50	34.00	29.00	28.75	37.41	25.25	28.00					W.	4	3	5	2	6	0	
																	E.	0	0	2	0	0	0	
Omitted		0	2	2	0	2	2	0	2	2	2	2		0	2	2		0	2	2	6	8	17	3.985
November.	Att. ther.	41.02	48.18	42.31													N.	2	0	0	1	2	0	
																	N.W.	12	15	11	6	6	1	
																	N.E.	0	1	3	0	0	0	
	Average	29.59	29.54	29.57	35.12	45.50	38.30	33.92	39.98	34.56	10.90	41.32	Ent. clr.	7	4	9	S.	2	3	0	0	0	0	
	Maximum	29.92	29.80	29.88	55.00	65.00	54.00	52.00	57.50	56.44	21.63	60.00	Ent. cld.	9	9	9	S.W.	4	1	2	2	1	0	
	Minimum	29.20	28.92	29.24	19.50	33.00	23.50	19.00	31.25	14.61	0.00	28.00	Part. clr.	11	12	9	S.E.	0	3	5	0	0	0	
	Range	.72	.88	.64	35.50	32.00	30.50	33.00	26.25	41.83	21.63	32.00					W.	4	2	6	4	5	1	
																	E.	3	0	0	0	0	0	
Omitted		3	5	3	3	5	3	0	6	5	5	5		3	5	3		3	5	3	7	7	16	3.190
December.	Att. ther.	35.67	39.12	37.11													N.	1	1	2	1	1	0	
																	N.W.	12	8	6	6	5	2	
																	N.E.	4	4	3	0	1	0	
	Average	29.56	29.52	29.56	30.92	38.35	32.23	28.93	33.79	28.13	10.17	35.13	Ent. clr.	5	2	6	S.	3	3	1	0	0	0	
	Maximum	30.02	29.96	30.07	40.00	45.50	41.50	39.00	40.00	42.50	21.85	42.50	Ent. cld.	14	15	13	S.W.	2	3	5	0	0	0	
	Minimum	29.25	29.21	29.25	9.50	30.50	13.00	7.50	20.75	12.67	0.00	26.00	Part. clr.	11	6	9	S.E.	3	0	6	0	0	0	
	Range	.77	.75	.82	30.50	15.00	28.50	31.50	19.25	29.83	21.85	16.50					W.	3	3	2	5	4	0	
																	E.	2	1	3	0	0	0	
Omitted		1	8	3	1	8	2	0	8	8	8	8		1	8	3		1	8	3	13	10	20	3.336

Meteorological Journal—Continued.

		Average of 1843.												*Total of* 1843.														
		Barometer.			External Thermometer.					Hygrom'r, 2 P.M				Sky.				Winds.				Clouds.				Rain.	
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r	Mean	Dew point.	Diff. dw pt &tem	Wet bulb.		7 A.M Days	2 P.M Days	9 P.M Days		7 A.M Day-	2 P.M Days	9 P.M Days	7 A.M Days	2 P.M Days	9 P.M Days	Rain Gauge, Inches.	
1843.	Att. ther.	49.75	58.27	52.42													N.	25	19	21	2	16	1		
																	N.W.	108	108	87	54	66	14		
																	N.E.	35	24	42	2	6	0		
	Average	29.52	29.50	29.52	45.82	56.96	47.94	44.31	50.39	42.95	11.60	50.20	Ent. clr.	96	38	126	S.	29	35	21	3	10	0		
	Maxim'm	30.06	30.06	30.12	79.00	90 50	79.00	78.00	83.50	75.00	44 54	78.00	Ent. cld.	120	96	106	S.W.	41	51	39	29	41	2		
	Minimum	28.75	28.53	28.78	3.00	18.00	9.00	2.00	14.00	−4.90	0.00	17.00	Part. clr.	131	196	114	S.E.	38	34	66	6	9	1		
	Range	1.31	1.53	1.34	76.00	72.00	70.00	76.00	69.50	79.90	44.54	61.00					W.	40	42	49	61	85	14		
																	E.	31	17	20	5	10	0		
Omitted		17	35	19	16	34	18	0	36	36	36	36		18	35	19		18	35	20	93	59	187	45.423	
		Average of Winter Months, 1842-3.												*Total of Winter Months*, 1842-43.														
Winter, 1842-43.	Att. ther.	33.57	40.59	36.17													N.	4	6	5	2	1	0		
																	N.W.	32	37	38	23	23	8		
																	N.E.	7	9	13	0	1	0		
	Average	29.47	29.44	29.47	28.23	38.82	30.56	27.47	32.63	26.43	11.90	35.09	Ent. clr.	18	15	30	S.	5	7	1	1	2	0		
	Maxim'm	30.06	30.06	30.12	53.00	60.00	50.00	49.00	51.75	56.50	30.90	56.50	Ent. cld.	30	30	32	S.W.	12	7	4	4	7	0		
	Minimum	28.75	28.53	28.78	3.00	18.00	9.00	2.00	14.00	−4.90	0.00	17.00	Part. clr.	40	40	25	S.E.	12	10	12	0	0	1		
	Range	1.31	1.53	1.34	50.00	42.00	41.00	47.00	37.75	61.40	30.90	39.50					W.	10	8	9	15	12	3		
																	E.	6	1	5	1	0	0		
Omitted		1	5	3	0	5	3	0	4	5	5	5		2	5	3		2	5	3	24	24	45	7.306	
		Average of Spring Months, 1843.												*Total of Spring Months*, 1843.														
Spring, 1843.	Att. ther.	45.05	54.88	48.38													N.	3	5	5	0	5	1		
																	N.W.	35	32	21	14	20	2		
																	N.E.	12	6	11	0	2	0		
	Average	29.45	29.41	29.44	41.43	53.68	43.57	38.14	45.90	36.43	17.12	46.19	Ent. clr.	23	12	34	S.	6	6	5	1	1	0		
	Maxim'm	29.83	29.84	29.80	67.00	85.00	71.00	64.50	74.75	67.00	44.54	71 50	Ent. cld.	36	26	35	S.W.	4	10	10	5	12	0		
	Minimum	28.76	28.54	28.92	13.50	19.00	11.00	10.00	17.00	4.61	0 00	17.00	Part. clr.	33	51	22	S.E.	10	10	22	4	5	0		
	Range	1.07	1.30	.87	53.50	66.00	60.00	54.50	57.75	62.39	44.54	54.50					W.	10	10	13	18	18	3		
																	E.	12	10	4	4	4	0		
Omitted		0	3	1	0	3	1	0	3	3	3	3		0	3	1		0	3	1	23	12	51	11.125	

Average of Summer Months, 1843. | *Total of Summer Months*, 1843.

		Barometer.			External Thermometer.					Hygrom'r, 2 P.M.			Sky.				Winds.			Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M	2 P.M.	9 P.M.	Reg'r	Mean	Dew point	Diff. dw pt &tem	Wet bulb		7 A.M Days	2 P.M Days	9 P.M Days		7 A.M Days	2 P.M Days	9 P.M Days	7 A.M Days	2 P.M Days	9 P.M Days	Rain Gauge. Inches.
Summer, 1843.	Att. ther.	68.88	79.20	72.43													N.	8	6	5	0	6	0	
																	N.W.	18	15	13	6	9	2	.
																	N.E.	11	5	14	1	0	0	
	Average	29.58	29.57	29.57	66.28	78.37	68.56	64.32	71.54	63.58	15.20	68.47	Ent. clr.	26	6	38	S.	9	12	11	1	6	0	
	Maxim'm	29.88	29.88	29.88	79.00	90.50	79.00	78.00	83.50	75.00	26.53	78 00	Ent. cld.	21	15	12	S.W.	12	20	15	13	16	0	
	Minimum	29.22	29.20	29.26	42.00	55.50	44.00	37.00	49.25	34.23	0.00	46.00	Part. clr.	38	65	41	S.E.	9	10	20	1	3	0	
	Range	.66	.68	.62	37.00	35.00	35.00	41.00	34.25	40 77	26.53	32.00					W.	11	14	10	21	36	7	
																	E.	7	4	2	0	5	9	
Omitted		7	6	1	7	6	1	0	7	7	7	7		7	6	1		7	6	2	19	6	43	12.415

Average of Autumnal Months, 1843. | *Total of Autumnal Months*, 1843.

Autumn, 1843.	Att. ther.	51.74	60.11	53.42													N.	10	3	5	1	4	0	
																	N.W.	26	31	25	11	20	4	
																	N.E.	3	6	7	1	2	0	
	Average	29.57	29.56	29.58	47.52	58.29	49.59	46.55	52.33	46.11	12.11	52.24	Ent. clr.	30	6	26	S.	8	9	3	0	1	0	
	Maxim'm	29.93	29.94	29.89	72.50	87.00	75.50	72.50	79.75	73.62	25.25	77.00	Ent. cld.	30	22	27	S.W.	14	12	7	9	8	2	
	Minimum	29.09	28.92	29.18	19.50	33.00	23.50	19.00	31.25	14.61	0.00	28.00	Part. clr.	23	50	27	S.E.	7	5	10	1	1	0	
	Range	.84	1.02	.71	53.00	54.00	52.00	53.50	48.50	59.01	25.25	49.00					W.	10	10	16	8	18	2	
																	E.	5	2	7	0	1	0	
Omitted		8	13	11	8	13	11	0	14	13	13	13		8	13	11		8	13	11	23	18	46	14.015

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Third Report of Meteorological Observations made at Frankford Arsenal, near Philadelphia. By Captain ALFRED MORDECAI, *of the Ordnance Department.*

The results of the meteorological observations, made at Frankford Arsenal, during the three years ended on the 30th April, 1838, have been given in two previous reports, published in the Journal of the Franklin Institute, vol. xix, p. 7, and vol. xxii, p. 30. By the care and attention of Mr. Pigott, the clerk of the Arsenal, observations of the thermometer and rain gauge have been continued up to the end of the year 1843; and in order that they may be made available, for reference and comparison with other observations of a like character, a general abstract, or synopsis, of the whole series of observations, during eight years, is now presented.

I.—*Of the Temperature.*

Since 1838, only two daily observations of the thermometer have been made, viz.,

For the Maximum, at 2h. 30m. P. M. For the Minimum, in January, February, and March, at 6 A. M.; in April, September, October, November, and December, at 5 A. M.; in May, June, July, and August, at 4 A. M.

The general results of the observations, for eight years, are given in the following tables, No. I, to No. IV.

Table I, shows the mean temperature, or half the sum of the daily extremes, for each month, as well as for each season, and for the whole year; also the general mean for eight years.

Table II, shows the mean daily range of temperature, or the mean of the daily differences of extremes, for the same period as in Table I. By combining the numbers in these two tables, it will be easy to deduce the mean daily maximum, or minimum, for any stated period, since the first table gives half the sum, and the second table the difference, of the mean maxima and minima; and half the difference of two numbers added to half the sum, gives the greater, and subtracted from half the sum, gives the less.

Table III, shows the greatest daily range of temperature in each month, that is to say, the greatest change of temperature which has been observed in any day during the month; it will be remarked that the interval of time, during which this change of temperature has occurred, is from 8½ to 10½ hours, and that the change, during that time, has been, in several instances, as great as 39°. Further evidence of the great transitions of temperature in our climate, is afforded by Table IV, exhibiting the highest and the lowest temperatures observed in each month, and in each year.

TABLE I.

Mean Temperature of each Month, and of each Season.

Period.	1836	1837	1838	1839	1840	1841	1842	1843	8 years.
January,	27.72	27.40	36.80	31.44	27.21	34.14	34.79	39.48	32.37
February,	22.72	31.86	24.58	35.15	40 36	31.93	39.11	29.38	31.89
March,	33.54	38.80	40.72	43.61	45.16	44.07	47.65	32.38	41.74
April,	48.30	47.98	46.16	55 25	56.18	49.76	53.46	51.40	51.06
May,	61.51	59.53	57.95	64 30	62.31	59.91	60.51	59.91	60.74
June,	64.61	67.63	73.38	67.90	68.61	73.80	68.87	70.65	69.43
July,	73.49	72.41	79.99	76.68	72.81	76.30	76.65	75.26	75.45
August,	68.32	71.08	77.07	71.62	73.77	74.64	73.34	74.27	73.01
September,	67.38	62.50	66.30	65.56	62.08	68.13	68.07	68.88	66.11
October ,	48.36	54.36	52.58	57.71	56.23	49.98	58.52	54.03	53.97
November,	40.78	45.85	42.20	41.28	45.37	41.77	39.74	42.30	42.41
December,	32.47	35.30	31.05	36.10	31.80	35.27	32.24	35.71	33.74
Spring,	47.78	48.77	48.28	54.39	54.55	51.25	53 8	47.90	51.18
Summer,	68.81	70.37	76.81	72 07	71.73	74.91	72.95	73.39	72.63
Autumn,	52.17	54.24	53.69	54.85	54.56	53.29	55.44	55.07	54.20
Winter,	27.64	31.52	30.81	34.23	33.12	33.78	35.38	34.86	32.66
Year,	49.10	51.23	52.40	53.88	53.49	53.31	54.41	52.80	52.66

TABLE II.

Mean daily range of Temperature.

Period.	1836	1837	1838	1839	1840	1841	1842	1843	8 years
January,	11.73	10.40	13.74	14.37	12.36	9.66	11.65	14.28	12.27
February,	16.04	12.12	10.38	12.24	15.71	13.72	12.73	11.63	13.07
March,	17.92	14.52	14.60	14.97	18.00	16.70	14.53	14.56	15.73
April,	18.50	16.81	13.18	22.55	19.55	15.45	15.52	16.53	17.26
May,	20.00	15.39	13.06	19.10	18.42	20.56	19.92	11.79	17.28
June,	12.42	12.28	15.79	17.20	20.56	18.66	16.08	10.71	15.46
July,	12.53	12.42	16.15	17.43	15.61	18.43	14.53	12.71	14.98
August,	11.31	11.34	15.11	12.98	14.47	15.93	14.16	9.84	13.14
September,	9.77	14.72	13.83	13.80	19.53	12.93	16.58	9.92	13.88
October,	12.73	13.98	11.61	14.53	16.95	13.58	20.77	13.61	14.72
November,	11.71	13.93	12.01	12.73	14.02	8.88	13.82	10.33	12.18
December,	10.60	11.98	12.19	9.60	11.40	9.61	8.87	10.27	10.57
Spring,	18.81	15.57	12.61	18.87	18.66	17.57	16 66	14.29	16.76
Summer,	12.09	12.01	15.68	15 87	16.88	17.67	14.92	11.09	14.53
Autumn,	11.40	14.21	12.48	13.67	16.83	11.80	17.06	11.29	13.59
Winter,	12.79	11.50	12.10	12.07	13.16	11.00	11 08	12.04	11.97
Year,	13.77	13.32	13.47	15.12	16.38	14.51	14.93	12.18	14.21

TABLE III.

Greatest daily range of Temperature in each month.

Month.	1836	1837	1838	1839	1840	1841	1842	1843	Average of eight years.
January,	27.5	27.50	25.5	32.50	22.50	19.00	24.00	25.50	25.50
February,	28.5	22.	22.	21.50	34.00	25.00	24.50	27.00	25.56
March,	29.5	26.	24.	30.00	32.50	39.00	33.50	29.00	30.44
April,	32.75	30.	29.	39.00	31.00	31.50	29.00	29.00	31.41
May,	33.50	26.	27.00	31.50	28.00	28.00	30.50	20.50	29.38
June,	27.00	21.50	28.50	28.50	30.00	36.00	31.50	21.00	28.
July,	22.00	18.5	22.00	25.00	24.00	30.00	23.50	22.00	23.38
August,	22.00	22.	24.00	27.00	25.00	23.00	25 50	17.00	23.19
September,	18.50	23.5	32.00	27.00	33.00	21.00	26.00	18.00	24.88
October,	24.00	29.5	22.50	27.00	33.00	24.00	39.00	27.00	28.25
November,	23.5	28.	24.00	23.50	27.50	25.00	24.00	25.00	25.06
December,	33.	26.50	23.00	25.00	25.	32.00	16.00	24.00	25.56

TABLE IV.

Extreme range of Temperature in each month, and in each year.

		1836	1837	1838	1839	1840	1841	1842	1843	Average of eight years.
January,	Max.	48.50	47.5	61.5	56.	50.	61.	56.	66.5	55.88
	Min.	2.50	6.	18.	6.	5.	5.	14.	11.	8.44
February,	Max.	48.	49.5	55.	52.	70.	54.	61.	47.	54.56
	Min.	-7.	10.5	10.	13.	3.	4.	15.	7.	6.94
March,	Max.	53.5	61.	63.	77.	72.	77.	69.	57.5	66.25
	Min.	11.5	7.	18.	16.	20.	21.	26.	15.	16.81
April,	Max.	77.25	79.5	73.5	81.	85.	73.	77.	77.	77.91
	Min.	26.	30.	27.	32.	30.	30.	28.	29.	29.
May,	Max.	87.	81.25	82.	86.	86.	94.	83.	79.	84.78
	Min.	39.	32.	40.	40.	40.	32.	43.	45.	38.88
June,	Max.	88.5	84.	90.	87.5	89.	95.	88.5	87.	88.69
	Min.	48.	53.	50.	49.	47.	51.	42.	42.	47.75
July,	Max.	89.	86.5	96.	92.	90.	97.5	92.5	94.	92.19
	Min.	57.	60.	60.	59.	56.	56.	61.	58.	58.38
August,	Max.	84.5	89.	92.	87.	89.	90.	86.5	85.5	87.94
	Min.	49.	55.5	55.	55.	56.	58.	55.	61.	55.56
September,	Max.	86.	79.5	86.	84.5	84.	88.	86.	86.	85.
	Min.	43.	44.	50.	43.	35.	55.	40.	42.	44.
October,	Max.	73.	77.5	75.	75.	75.	65.	86.	73.	74.94
	Min.	30.	31.	35.	34.	29.	30.	37.	35.	32.63
November,	Max.	67.	70.	64.	58.5	66.	72.	62.	66.	65.69
	Min.	24.	23.	18.	18.	27.	20.	18.	23.	21.38
December,	Max.	56.	62.5	48.	58.5	52.	50.5	47.	49.5	53.
	Min.	10.	19.	10.	14.	14.	15.	15.	15.	14.
Year,	Max.	89.	89.	96.	92.	90.	97.5	92.5	94.	92.50
	Min.	-7.	6.	10.	6.	3.	4.	14.	7.	5.38
	Extreme range.	96.	83.	86.	86.	87.	93.5	78.5	87.	87.12

II.—*Of the Rain.*

The observations on the rain have been, since 1838, confined to the station on the ground, the position of which is described in the second report above referred to. The gauges for measuring the snow, as well as the rain, have been used at this station, and the general results of the observations are given in Table V.

Table VI, shows the number of days in which the quantities of rain and snow, recorded in Table V, have fallen.

Table VII, shows the average quantity of rain which has been received from different quarters of the compass. From this statement it appears, that in the summer season about *one-half*, and in each of the other seasons *two-thirds*, of the whole quantity of rain comes from the N.E.; of the remaining quantity about one-half comes from the S.W.

The slight discrepancies which may be remarked, in comparing the general averages in Tables V and VII, arise from the circumstance that the observations during the last eight months of 1835, (being the beginning of the series,) are included in the averages of Table VII, but not in those of Table V.

The following cases of remarkably heavy rains, which have occurred during the period of these observations, are considered worthy of special notice:—

In 1838, September 12th and 13th, there fell, in 25 hours, 5.174 inches of rain, wind N.E.

In 1840, April 11th and 12th, there fell, in 17½ hours, 3.381 inches of rain, wind S.W.

In 1840, August 12th and 13th, there fell, in 24 hours, 3.137 inches of rain, wind S.W.

In 1841, August 10th and 11th, there fell, in 17 hours, 5.330 inches of rain, wind S.W.

In 1842, July 15th and 16th, there fell, in 13½ hours, 3.179 inches of rain, wind N.E.

In 1843, August 5th, there fell, in 14½ hours, 4.080 inches of rain, wind N.E.

In 1843, August 7th, there fell, in 1 hour, 1.018 inches of rain, wind S.W.

In the city of Philadelphia the fall of rain, on the 5th of August, 1843, was 4.5 inches in 1½ hour, and about Chester, in Pennsylvania twenty miles south of Philadelphia, the rain was still heavier.

TABLE V.

Quantity of Water fallen in Rain, or Snow, in each Month, and in each Season.

Period.	1836	1837	1838	1839	1840	1841	1842	1843	Mean of 8 years.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January,	5.138	1.745	1.721	4.163	1.886	6.600	1.221	2.056	3.066
February,	2.498	2.809	1.549	2.531	2.808	2.001	3.704	2.146	2.506
March,	1.420	3.425	2.242	1.015	2.304	3.797	2.766	3.921	2.611
April,	3.019	1.969	2.841	1.434	6.649	5.277	4.133	3.471	3.599
May,	1.929	4.351	3.220	5.519	2.086	2.744	4.421	2.132	3.300
June,	7.665	2.814	4.192	3.818	4.723	5.359	3.202	4.157	4.491
July,	1.917	3.677	1.865	2.025	4.704	3.425	8.381	4.276	3.784
August,	2.356	4.579	1.199	4.566	6.352	9.762	3.309	9.048	5.146
September,	1.906	2.228	8.492	2.865	1.970	2.674	1.062	4.780	3.247
October,	2.929	0.569	3.667	2.369	3.765	2.338	1.564	3.484	2.586
November,	2.921	2.386	2.787	3.198	2.360	5.030	2.986	4.186	3.232
December,	3.850	2.367	0.686	5.173	2.549	4.784	3.560	3.319	3.286
Spring,	6.368	9.745	8.303	7.968	11.039	11.818	11.320	9.524	9.510
Summer,	11.938	11.070	7.256	10.409	15.779	18.545	14.892	17.481	13.421
Autumn,	7.756	5.183	14.946	8.432	8.095	10.042	5.612	12.450	9.065
Winter,	11.486	6 921	3.956	11.867	7.243	13.385	8.485	7.521	8.858
Year,	37.548	32.919	34.461	38.676	42.156	53.790	40.309	46.976	40.854

TABLE VI.

Number of Days in which Rain, or Snow, fell in each Month, and in each Season.

Period.	1836	1837	1838	1839	1840	1841	1842	1843	Average.
January,	15	9	9	9	7	14	7	9	10
February,	13	9	8	7	11	7	11	9	9
March,	9	13	10	7	11	11	16	9	11
April,	12	9	10	7	8	19	15	13	12
May,	11	9	17	14	9	15	16	10	12
June,	15	16	8	14	8	13	14	6	11
July,	6	9	6	12	10	7	11	9	9
August,	12	8	3	14	9	11	12	10	10
September,	11	8	9	9	8	7	5	10	8
October,	8	5	8	7	10	9	8	10	8
November,	8	9	7	7	9	14	10	13	10
December,	8	8	7	14	10	11	10	11	10
Spring,	32	31	37	28	28	45	47	32	35
Summer,	33	33	17	40	27	31	37	25	30
Autumn,	27	22	24	23	27	30	23	33	26
Winter,	36	26	24	30	28	32	28	29	29
Year,	128	112	102	121	110	138	135	119	120

TABLE VII.

Average quantity of Rain, or Snow, annually, from each quarter of the compass in eight years.

1836 to 1843	N. E.	S. E.	S. W.	N. W.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.
January,	2.159	0.394	0.263	0.250	3.066
February	1.936	0.050	0.453	0.068	2.507
March,	2.050	0.165	0.334	0 062	2.611
April,	2.115	0.673	0.479	0.332	3.599
May,	2.160	0.219	0.443	0.355	3.177
June,	2.135	0.512	1.245	0.570	4.462
July,	1.960	0.103	1.515	0.469	4.047
August,	2.043	0.159	1.786	0.864	4.852
September,	2.202	0.248	0.485	0.273	3.208
October,	1.715	0.149	0.257	0.307	2.428
November,	2.076	0.196	0.279	0.639	3.190
December,	2.272	0.219	0.225	0.516	3.232
Spring,	6.325	1.057	1.256	0.749	9.387
Summer,	6.138	0.774	4.546	1.903	13.361
Autumn,	5.993	0.593	1.021	1.219	8. 26
Winter,	6.367	0.563	0 941	0.834	8. 05
Year,	24.823	3.087	7.764	4.705	40.379

Mr. Austin's Apparatus for Fitting Ships' Boats as Life Boats, in cases of shipwreck, and for raising Sunken Vessels.

Mr. Austin, formerly harbor-master at the island of Heligoland, suggests the following plan as sufficiently simple to be within the reach of every vessel in such emergencies:—

When a vessel is driven on the rocks, sand, or shore, or founders at sea, in getting the boats over the side they are frequently stove alongside the wreck before the tackles can be unhooked, and, even if cleared off the tackles, it too often occurs that they are stoved, swamped, or upset, when brought alongside to receive the passengers and crew. To avoid such calamities, Mr. Austin recommends that every boat, before she is launched over the side, should be fitted as a life boat, with canvas cases on each side, of the whole length of the boat, having a round head at either end marled on to a good hawser, or small chain, and secured round her at light water mark, tautened up by nettles to the gunwale. The cases may be cut out of good topsails, or courses, and made from two to three feet in diameter; another case of lighter cloth of duck, or even of calico, should be made, rather larger in dimensions, and placed within the stout canvas case, each case having three flexible tubes, or pipes, inserted at the bottom part, one near to each head, and one in midships, made of raw hide, India rubber cloth, or several thicknesses of canvas, about a fathom in length, and half an inch in diameter, with a mouth piece, or pipe, to be blown into, and stopped, or corked. The long boat and skiff should be placed on two spars projected over the side, for the purpose

of launching them; the cases, well saturated with water, filled with air, stopped, and the boat launched, with plenty of warp slack under foot, and not brought up with less than half a cable, each boat having only two hands in her when launched, with a line passed round them and stopped to the thwart to bale her out, and to receive the passengers and crew, who should have a smaller similar case placed round each of them.

The boats so fitted would contain, with safety, double the number of persons they could possibly hold under ordinary circumstances, and would not be upset in a heavy sea, and, on going on a lee shore, would hold together and drive well up.

If the weather and sea should admit of the boats being brought alongside the wreck, the cases being filled with air would serve as flexible fenders, and allow her taking in a number of persons to be removed to the other boats.

Raising Sunken Vessels.—According to Lloyd's List, taking an average of three years, not fewer than 557 vessels are sunk, or altogether lost annually.

A vessel having gone down, the first operation is to ascertain her position as nearly as possible, by sweeping with a rope of sufficient length, having two leads fixed thereto, at about sixty fathoms apart, the object of which is to draw the rope along the bottom till it meets with an obstruction. It is easily ascertained, by sounding, whether he obstruction to the progress of the sweeping rope is caused by the vessel, or by an anchor, or other object; if it be the vessel, it is necessary to ascertain the position in which she lies; this is done by again sweeping the vessel with a small working chain, properly buoyed at equal distances, which will show her length and beam. To ascertain if the bowsprit is still standing, it is necessary to sound again at each end of the vessel. The purchase chain is next passed round the vessel, having a sufficient number of collapsed air cases, formed as above described, shackled on to it, and when tautened round her by means of other cases, or purchase lighters, the chain is effectually secured round the vessel by stoppers. The operation of filling the air cases is next proceeded with, which is effected by powerful air pumps on board a steam vessel taken out for the purpose, and as the displacement of the water is going on, the vessel is gradually being raised from her bed, and by the time they are filled she will be above the surface of the water, and ready to be towed to shore by the steamer.

Trans. Soc. Arts, &c.

Description of a machine for Blocking Straw Bonnets. *By* Vincent Price, *of Soho.*

The object of bonnet pressing is to give to the work a finished appearance, after the plait is sewn together.

This operation is usually performed by placing the bonnet on a wooden block of the required form, and pressing it with a heated box

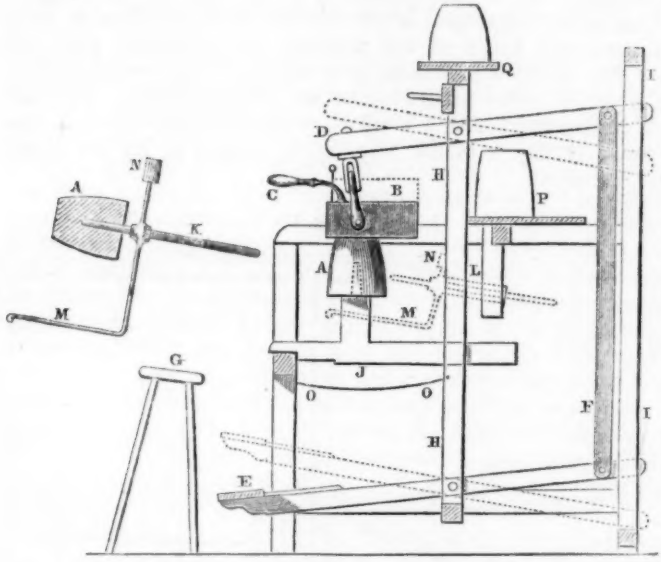
iron, a damp cloth having been first applied to it to prevent the material from being discolored.

The blocker increases the pressure of the iron by throwing the weight of his body upon it, a practice frequently productive of serious bodily injury.

The object of Mr. Price's machine is to obviate this serious defect in the ordinary mode of blocking bonnets. The accompanying view exhibits the several parts of the machine.

Fig. 2

Fig. 1.



A, fig. 1, is one of the blocks in a position to receive a bonnet; B, is the box iron, with its handle C, which is hung with double joints and swivel to the lever D, which is connected with the treadle E, by means of the vertical bar of iron F, the weight of which is sufficient to overbalance the box iron B, and treadle E, and raise them up, as shown by the dotted lines.

Instead of standing, as usual, the blocker sits on the stool G, and by his feet on the treadle, lowers the box iron, which he can guide and turn in any direction by its handle C.

The middle upright bars H and I, of the frame are made double, to serve as guides to the lever D, and treadle E, and also to receive the movable cross bar J, which supports the block A. When the sides are to be blocked, the bar J, is lifted out of its place, and the axis K, fig. 2, is put into the metal socket L, shown by dotted lines, fig. 1, the block A, being placed on the end of the axis, as seen in fig. 2. To the axis K, is attached an arm M, which is moved by either hand of the blocker, so that the bonnet may be turned quite round under the iron; the arm has a balance weight N. O O, is a net stretched across

the whole space before the blocker, on which the bonnet may be laid. P and Q, are two shelves on which to place blocks of different sizes.

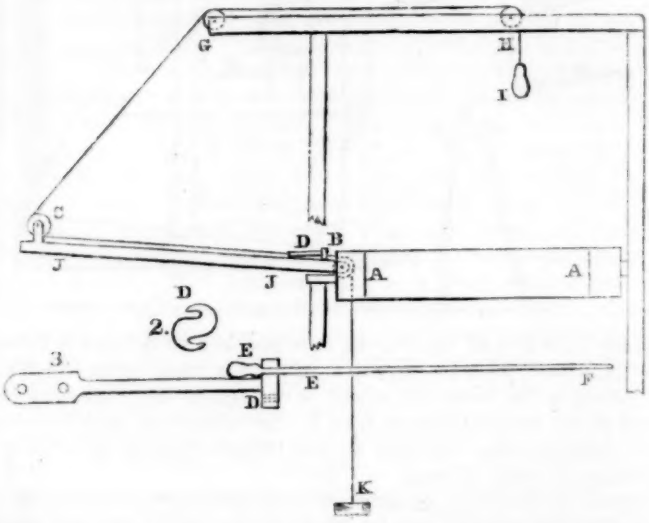
Trans. Soc. Arts, &c.

Description of a machine to draw out Terry-Wire. By JOHN FERRY, *of Bethnal-Green.*

The wires used in weaving terry, or uncut velvet; are usually put in and pulled out of their places by the thumb and first finger of the left hand of the operator, which causes great soreness to the ends of the thumb and finger of the weaver, and continual pain in the left arm. Mr. Ferry's invention is to obviate these inconveniences.

A A, fig. 1, is the breast roll of an ordinary loom. The wire F F, fig. 2, is furnished with a knob E, made of bone, which is caught by the hook D, fig. 3, of the key, fig. 2, instead of by the thumb and finger, as usual.

Fig. 1.



To the end of the key, fig. 2, is attached a cord, which passes over the pulleys C, G, and H, to a lightly weighted handle I, which, being pulled down by the right hand of the operator, draws out the wire in the direction of C, along the inclined plane J J, from which the weaver removes it, ready to draw out the next wire in order; another cord may be attached to the key with a weight K, fastened to it, in order to return the hook from C to D.

Ibid.

Description of an improvement in the Coast Mortar, in use for saving the lives of persons in cases of shipwreck. By Capt. T. M. Bagnold, *of Saxmundham, Suffolk.*

The mortar at present in use for saving the lives of shipwrecked persons, although generally known as Captain Manby's, was really the proposal of Lieut. Bell, of the Royal Artillery, and to him the Society's reward was voted, much about the time of Captain Manby's birth, and Mr. Bell's model being extant in the Society's collection, it may, perhaps, assist the committee in forming their opinion of my proposed improvement.

The mortar, as sent from the laboratory at Woolwich, is so fitted on its bed that the axis of the bore, is, as nearly as possible, at an angle of 45° with the horizon, and if it could be always used upon a level platform, this, its true elevation, would be permanent. But, it will be obvious, that when the mortar is carried in haste, either to a sandy, or shingle, beach, there is no immediate means of ascertaining that it has this due degree of elevation, or that it is, as it ought to be, level in the transverse direction, or in a line at right angles to the direction of the shot; and as all beaches slope more or less rapidly towards the water, this error is of constant, I may say, of invariable, occurrence; hence arises two errors in the flight of the projectile, the slope of the beach detracts greatly from the elevation, thereby shortening the range, and the transverse error causes a lateral deviation in the flight of the shot from the line it was intended to take.

In mortar practice from level batteries, the *elevation* of the piece is ascertained by an instrument called the gunner's quadrant, which, by means of a plummet, shows the true angle; then a gunner's spirit-level being applied across the upper surface of the mortar, at the muzzle a small mark is made, corresponding to the centre of the air bubble. This operation is repeated on the ring near the touch hole, and a chalk line is struck, connecting these two points, which is technically called *the upper line of metal.* The gunner, standing behind the piece, holds up a plumb line, and causes the mortar to be trained until the plumb line in his hand cuts the chalk line on the gun, and the object to be aimed at; the piece is then ready for firing.

The solid platform remaining level, no further use of instruments is required; but it will be seen, that as the firing upon a sandy, or shingly, beach, moves the position of the gun at every shot, and disturbs the loose materials it stands on, fresh applications of these instruments would be required at each discharge; and the Government, well knowing the impracticability of using them in blowing weather, and dark nights, in such exposed situations, have very properly withheld the supply of them.

During the heavy gales of last winter, a brig came on shore about a mile below the town of Aldborough, and every effort was made by the coast-guard and beach-men to save the crew. The wreck was barely 200 yards from the beach; the men deceived by the slope,

every shot fell short. Increased charges were then tried, the result of which was the regular breaking of the rope at each fire, and the loss of the shot, and part of the line.

These circumstances induced me to turn my attention to the subject, and I flatter myself I have succeeded in fitting to the mortar *a simple, cheap, and efficacious means, which, in the first place, enables the most unpracticed person to ascertain the true elevation and transverse level of the gun in an instant, even in the darkest night, and to correct them with the greatest ease under any circumstances of the weather, or situation.*

My improvement has another very considerable advantage attached to it, viz., as the proper elevation and level can be given to a certainty without the use of instruments, *the upper line of metal, or line of direction, on the gun, becomes* PERMANENT, and is, therefore, *painted with white upon the piece,* instead of being found and struck each time upon it with chalk; so that the three operations of elevating, leveling, and pointing, are reduced to a single observation, whereby much valuable time is saved where a wreck is in momentary danger of going to pieces, or the sufferers rapidly sinking under cold and exhaustion.

Captain Wheatley, R. N., the Inspecting Commander of the Coast-guard here, is so pleased with the plan, that he is about to apply it to the two other guns under his charge on this coast, and will report in its favor to the Board; if adopted by them, the apparatus will, in future supplies, be fitted at the Arsenal; but to those at present in use it may be applied by any village blacksmith, premising that a gunner's level must be used in the fitting, which might be passed from station to station round the coast in the usual times of communicating; a quadrant may be made by any carpenter sufficiently accurate for the object in view; indeed, any level would answer the purpose, if fixed for temporary use, as shown in fig. 3.

The mortar, on its bed, with the wedge in its proper and fixed position, is to be laid on a table, bench, or on the ground, if *nearly* level; the quadrant being applied to the gun, and wedges, stones, or pieces of wood, are to be placed under the *fore*, or *hind*, part of the bed, as required, until the quadrant shows an elevation of 45°. A chalked plumb line is next hung down the *side* of the bed, and the perpendicular line struck upon it; this line is to be well cut into the wood, say a quarter of an inch in depth, and of the same width, and the groove painted white. A small iron pendulum, having been previously prepared, is to be hung, by means of a screw driven into the wood, in such a position that its fiducial, or chamfered, edge should be in a perpendicular position, and close by the side of the groove. The level is next to be applied in the transverse direction of the bed, and the lower side raised as required, as the end was raised in the previous operation; the plummet being hung down the *back part* of the bed, the line is to be struck and cut into the wood, and the pendulum, &c., fixed as before.

Whilst the gun is in this position, the level is to be applied to the

muzzle and base rings, as previously mentioned, and the true upper line of metal being found, is to be *painted* on the mortar.

Fig. 1, shows the mortar on its bed, at an elevation of 45° by its wedge, or quoin. The grooves A A, and B B, and pendulums C and D, with their guard irons E E, are shown at the side and train of the bed. The former of these shows the correct elevation, and the latter proves the painted line F, on the upper surface of the gun, to be in a plane vertical to the horizon, and passing through the axis of the bore. Any deviation from inequality of ground is immediately detected by one, or both, pendulums.

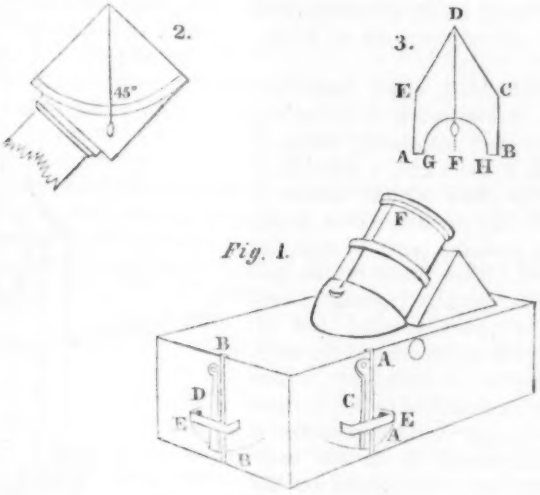


Fig. 1.

Fig. 2, shows a temporary quadrant, made from a rectangular piece of board, the plummet hanging on a line bisecting the arc, whilst one edge of the board being kept against the muzzle of the piece, gives the elevation at 45°.

Fig. 3, shows a temporary level. Let A B C D E, be a piece of thin board, and D F, a line marked on the board, perpendicular to A B. A semi-circular opening being made at the bottom of the board, the points G H, are applied to the rings of the gun, and passed right and left (the board being held vertically,) until the pointed plummet touches the metal, and its suspending string covers the line D F.

These temporary instruments form no part of the proposal, but are merely inserted to show with what facility the mortars, now in use, can be regulated by tools within the reach of the humblest mechanic.

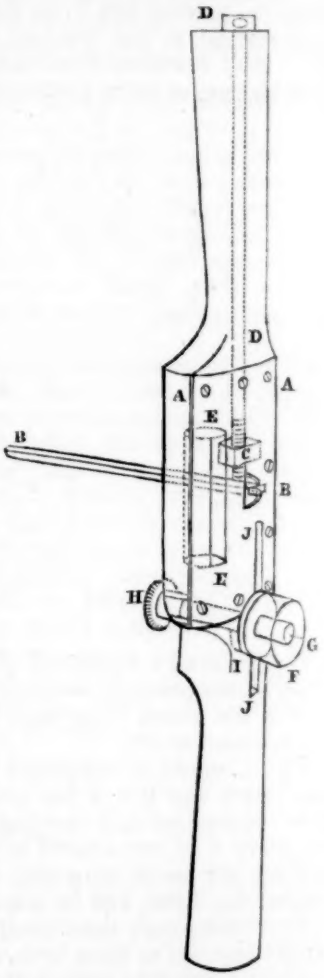
Ibid.

Description of an Improved Coach-makers' Fence-Router. By WILLIAM MIDDLETON.

The fence-router is a tool used by carriage builders for cutting out

the grooves in the framing of a coach body, into which are let the edges of the various panels.

The width of the groove is determined by the size of the cutting iron, and its distance from the edge of the framing is regulated by an adjustable iron fence. In the ordinary router the fence is fixed by two stop screws passing through a slot in the tail-piece of the stock, so that the fence may be adjusted to the required distance from the cutting iron; and the face of the fence is slightly curved, in order that the tool may work more freely in cutting out grooves in curved portions of framing.



Mr. Middleton's chief improvement is the substitution of a rolling fence F, for that ordinarily used, of which G H, is the axis; a slot J J, is formed in the stock which admits of the axis G H, of the roller being placed in a position parallel with the cutting iron. The fence, when adjusted to the required gauge, is secured by a milled-headed nut H, screwed on the upper end of the axis, and bearing on a collet by which pressure is transmitted to the surface of the wood; the counter-pressure is on a circular flanch I, of the same diameter as the roller fixed on the axis, and bearing on the iron face of the router. In order to prevent the fence turning in the slot, a square flanch is fixed to the other end of the axis; the friction on the working face of the router A A, is reduced by a roller E E, being let into the stock beneath the iron face A A, a small segment of which projects beyond the face through an opening formed therein.

Another improvement effected by Mr. Middleton, is the method of fixing the cutting iron B B, which is ordinarily done by the introduction of a wedge; whereas, in this improved router it is secured by the pressure of a long screw D D, passing from the left end of the stock quite through one arm thereof, to the cutting iron B B, and furnished with a nut C.

Ibid.

On the Preparation of Artificial Yeast. *By* GEO. FOWNES, *Ph. D.*

It often becomes a matter of great practical importance to have it in our power to excite the vinous fermentation under circumstances in which ordinary yeast cannot be obtained. In making bread, for example, although the use of yeast may be avoided by employing what is called "leaven," or dough which has already become sour, and partly putrefied by spontaneous change—a practice which has been followed from the most remote antiquity, and is still occasionally in use—the bread so made is always to be distinguished by a peculiar sour and nauseous taste and smell, and can never bear comparison with that fermented by yeast.

The object of the present notice is to point out a method by which yeast of the most unexceptionable quality can be artificially produced at will. I am aware that some substitute for ordinary ferment in brewing has long been known to certain persons, who go about the country and impart their secret to those who are willing to purchase it: of the nature of this preparation I am ignorant, and a reference to systematic chemical works will suffice to show that whatever it be it has never been made public.

On turning to Berzelius, it will be found stated,* that although the reproduction, as it were, of yeast, the conversion of a small into a large quantity, is a very easy thing, yet to produce that substance from the beginning is very difficult. He describes a process for this purpose on the authority of Dr. Henry, and which consists in taking a strong infusion of malt, saturating it with carbonic acid, and then exposing it for some days to the proper fermenting temperature, when a small quantity of yeast is gradually formed and deposited, which may, by various contrivances, be made to give origin to a larger. I shall have occasion to notice presently the behavior of a malt infusion when left to itself at a temperature of 70° or 80° F. for some time, and to show that the addition of carbonic acid is wholly unnecessary.

The principle of induced chemical action, which Liebig has assumed to explain a great number of those extraordinary phenomena to which Berzelius gave the term "Catalysis," and which principle has been so fully confirmed, and even, perhaps, extended by the late valuable researches of MM. Boutron and Frémy, on the formation of lactic acid, serves to solve this difficulty, as it will doubtless many others of far greater magnitude and importance. It has been shown that "the kind of chemical change going on in the decomposing azotized body of ferment, determines the kind of decomposition which shall occur in the neutral ternary substance, subject to its influence;" that diastase, for example, according to its peculiar condition, whether fresh from the germinated grain, slightly putrefied, or in a still more advanced state of that change, possesses the singular power, in the first case, of changing starch into dextrin, and ultimately into grape

* Lehrbuch, vol. viii, p. 89, foot note, third edition.

sugar; in the second, of causing the conversion of sugar into lactic acid; and in the third and last, of exciting the vinous fermentation.

Now if common wheaten flour be mixed with water to a thick paste, and exposed, slightly covered, to spontaneous change in a moderately warm place, it will be observed to run through a series of changes, which seem very closely to resemble those described by MM. Boutron and Frémy, in the case of diastase.

About the third day of such exposure it begins to emit a little gas, and to exhale an exceedingly disagreeable sour odor, much like that of stale milk; after the lapse of some time this smell disappears, or changes in character, the gas evolved is greatly increased, and is accompanied by a very distinct and somewhat agreeable vinous odor; this will happen about the sixth or seventh day, and the substance is then in a state to excite the alcoholic fermentation.

A quantity of brewers' wort is next to be prepared in the usual manner, by boiling with hops; and when cooled to 90° or 100°, the decomposed dough, before described, after being thoroughly mixed with a little tepid water, is added to it, and the temperature kept up by placing the vessel in a warm situation. After the lapse of a few hours, active fermentation commences; abundance of carbonic acid, having its usual agreeable pungent smell, is disengaged, and when the action is complete, and the liquid clear, a large quantity of excellent yeast is found at the bottom, well adapted to all purposes to which that substance is applied.

In one experiment the following materials were used:—a small handful of ordinary wheat flour was made into thick paste with cold water, covered with paper, and left seven days on the mantel-shelf of a room where a fire was kept all day, being occasionally stirred; at the end of that period three quarts of malt were mashed with about two gallons of water, the infusion boiled with the proper quantity of hops, and when sufficiently cooled, the ferment added. The results of the experiment were a quantity of beer, not very strong, it is true, but quite free from any unpleasant taste, and at least a pint of thick barm, which proved perfectly good for making bread.

It appears to me that this simple plan would enable distant residents in the country, and settlers in the colonies, to enjoy the luxury of good bread when a little malt could be got—a very easy home manufacture from grain of any kind; the hops might probably be omitted when the yeast alone was the object.

A moderately strong infusion of malt which has not been boiled, suffered to stand in a warm place for some days, speedily becomes sour and turbid, and begins to evolve gas; this change rapidly progresses, carbonic acid is given out plentifully, and a deposit of thick insoluble whitish matter formed, which readily excites fermentation in a dilute solution of sugar; the supernatant liquid contains alcohol, acetic acid, and, I believe, lactic acid.

When wort, which has been boiled and hopped, is set aside to decompose spontaneously, the change it undergoes appears to depend very much upon its strength. When weak, three or four days elapse before anything is noticed; a scum then collects upon the surface, and

a brown flocculent substance is thrown down, which is incapable of exciting fermentation in a solution of sugar, while the liquid gives off a flat, offensive smell. If the infusion experimented on be stronger, then the change is different; the liquid becomes turbid from the separation of a yellowish adhesive substance, a good deal of gas is very slowly emitted, alcohol is formed, and the deposit at the bottom of the vessel proves a pretty active ferment to sugar. The acidity of the liquid is but trifling, and its smell is somewhat disagreeable. These differences in the behavior of boiled wort may also depend upon the quantity of hops added, and the length of time during which the ebullition had been continued.

The effect produced in a spontaneously fermentable liquid by vegetable acids, or acid salts, such as cream of tartar, is a curious subject of inquiry. From an experiment made upon some wort, it appeared not improbable that the result of such addition showed an interference in the formation of lactic acid. We know that when the juice of grapes, or currants and gooseberries, is exposed to the air, the vinous fermentation is set up apparently at once; whereas in an unboiled infusion of malt, which is destitute of these substances, lactic acid seems to be first formed, although ultimately the two fermentations go on together.

I stated, when speaking of the spontaneous decomposition of wheaten dough, that an acid state preceded that in which it became an alcoholic ferment; and if in this condition it be mixed with a dilute solution of common sugar, and the whole kept warm for several days, it furnishes a sour liquid which is rich in lactic acid, and from which white crystalized lactate of zinc is easily prepared. There is a tendency in the liquid to run into the alcoholic fermentation, and to produce vinegar by a subsequent change, but still the quantity of lactic acid so formed is very considerable.

Common wheat-gluten then in its mode of decomposition strikingly resembles diastase; like that substance it runs in succession through two different dynamic conditions; it is successively a lactic acid, and an alcohol ferment; is it too much to expect that it might, by proper means, be detected in a third condition, namely, as a "sugar ferment," like diastase itself in the state in which it exists in malt? Is it not possible that diastase, as a definite proximate principle, has no more existence than yeast; that its powers are purely dynamic, and that it is, in short, nothing more than the gluten of the seed in one of its earliest stages of decomposition? This is an interesting inquiry, but its prosecution will be somewhat difficult, from the rapidity with which these changes succeed each other; it must be remembered that no one has yet succeeded in getting diastase in a state fit for analysis.

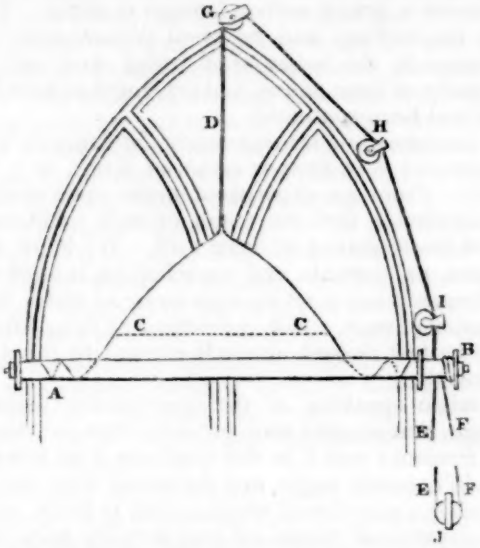
Mem. Lond. Chem. Soc.

Description of an Improved Gothic Window-Blind. By Mrs. Jemina Goode.

The ordinary method of fixing blinds for the upper parts of Gothic windows, is to attach the material of which the blind is composed, to

a frame of wood of the required form, which frame is fixed to that part of the window by screws, or otherwise.

The principal inconvenience of this plan is that, when not required to shade the sun, the blind cannot be drawn up, but remains fixed, and thus darkens the apartment in which it is used.



In order to obviate this defect, Mrs. Goode proposes to fix the roller A B, to which the holland, or other material, C C, is attached, across that part of the window where the contraction of the frame begins, the holland, or other material, being cut into the required shape, and the broad part being fixed to the roller A A. By attaching a line D, to the pointed end of the blind, and passing it over the pulleys G H I, fixed in the upper, or curved, portion of the frame, and thence round the pulley J, towards the bottom of the frame, and returning it to the roller to which it is secured, the blind is readily pulled up, or down.

To keep the blind in shape, wire stretchers may be sewn in across the holland, or other material, used for the purpose. The blind described above is the simplest of the two patterns sent.

Trans. Soc. Arts &c.

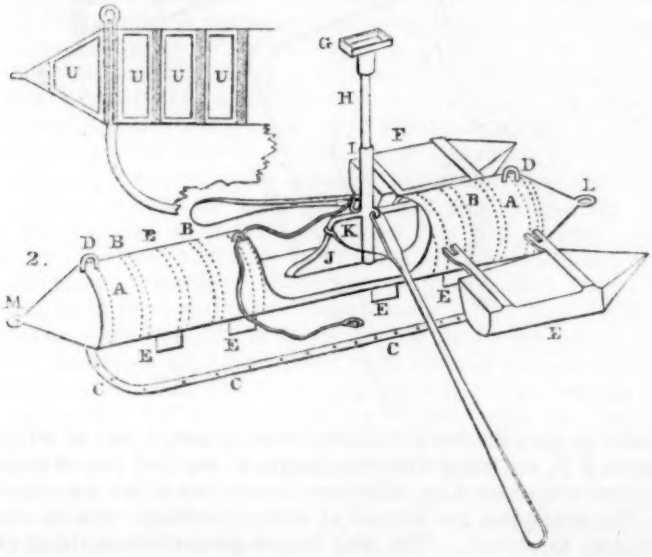
Description of an Improved Life-Buoy. By Com. BEADON, *R. N.*

Fig. 1, shows the buoy as it would appear when afloat. Fig. 2, a longitudinal section of part of the main float; and fig. 3, the mode of suspending the buoy at the stern of the vessel, and of letting it go when required.

The buoy is a cylindrical tube A A, made either of copper, or

sheet zinc, eight feet in length, and twelve inches across at its greatest diameter, each end being tapered off to a point, and furnished with eye-bolts L M, for the double purpose of attaching a rope, and of steadying it when suspended at the stern of the vessel by the eyes passing over guide-rods, one of which N, is shown in fig. 3; O O, in the same figure being arms to support the blades of the oar. The buoy, when suspended at the stern of the vessel, is kept in its place by a chain P, passing round under it to the hook Q. The sliding bolt R R, supports the hook Q. When it is required to lower the buoy, it is only necessary to raise the bolt by pulling the string S, the chain is released thereby, and the buoy drops into the water. C C C, the keel, which is from 10 to 12 inches in depth, and constructed of two pieces of bar iron, about $\frac{7}{8}$ inch by $\frac{3}{4}$ inch in size, having sheet metal riveted between them, and which is secured to the main float A A, by rivets passing through proper knees E E E. The ends of the iron binding of the keel C C C, are turned up, and, passing through the cylindrical main float, are secured to the rings D D.

Fig. 1.

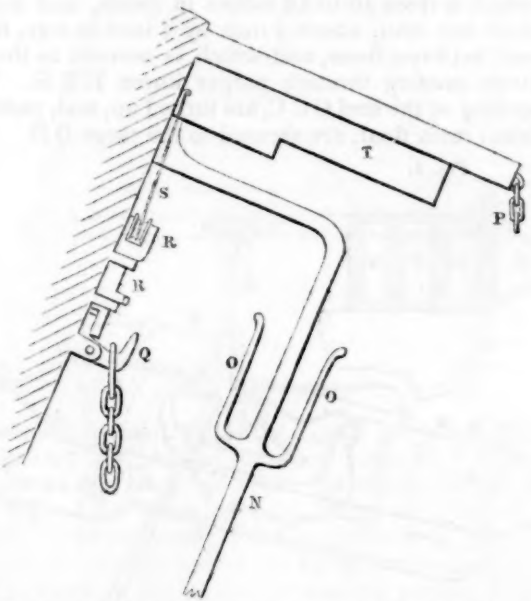


The main float is rendered stiffer and more secure by being divided into several compartments, which are separated from each other by wooden disks B B B, fig. 1. In these compartments are introduced metal drums, or vessels, U U U, so that, if by an accident to the outer coating of the buoy, leakage takes place, there is still the drum left entire, and filling the particular compartment. This is a very important feature in the invention, and particularly worthy of notice.

A saddle for a man to sit securely on the buoy, is formed in the central part of the main float, as seen in fig. 1; and in order to

strengthen this part of the buoy, a vertical partition J, is introduced, which also serves as a support for the cylindrical case I, in which the tube H, works up and down as occasion may require, and having a spiral spring at its lower end to keep it erect when the fuze-box G, is in use. When the buoy is suspended at the stern of the vessel, the fuze-box is kept dry by being pressed close under the cap T. The oars are hung to the cylindrical case I, by means of a collar surrounding it, to which are attached secure eye-bolts. A line K, is secured to each oar to prevent it from going too much in advance.

Fig. 3.



In order to give the buoy stability when in use, a pair of wings, or outriggers, F F, are hung with stop-hinges to the fore end of the main float, which are secured by bolts passing into two of the wooden disks B B. The outriggers are formed of semi-cylindrical vessels, having semi-conical fore ends. The stop hinges prevent them rising above the proper level, but when not in use they hang down close to the keel. Ibid.

On Eel-Skin Bands and Ropes. By Mr. Joseph Williams.

I have used eel skin upwards of twenty years, for drilling holes for pearls and diamonds, by which means I have a knowledge of its utility. I have tried whip cord, which will not last an hour; I have tried also cat gut, and that indeed is very little better. An eel-skin cut in three or four pieces of the same size as the gut, or string, will

last for three or four months certain, which shows the little wear to which it is subject. I have had them on the shelf for from six to twelve months, in the dusty shop, till they have been quite hard, yet they are as good as ever. When first I thought of weaving eel skins, it appeared to me that it would answer for the Blackwall Railroad, as their rope was always wearing out; and had I the means I should have made a long piece, for it may be made of any length by splicing the skins. I am convinced it would answer their purpose, as it wears so little, and would, I think, last for months with but few repairs. I have never sent any thing to your Society before: my business is that of a goldsmith and jeweller. Ibid.

Lord Rosse's Telescope.

At a meeting of the Belfast Natural History Society, the steps by which difficulties were overcome in making the speculum, were explained by Mr. Stevelly in detail, under the following heads:—

Metal for the Speculum.—The metallic alloy for the speculum consists of four atoms, or chemical combining proportionals of copper to one of tin, or by weight 126.4 copper to 58.9 tin. This alloy, which is a true chemical compound, is of a brilliant white lustre, has a specific gravity of 8.811; a twelfth of a cubic foot, or 144 cubic inches of it, weighing, therefore, a little over 45¾ lbs. avoirdupois, or to allow for all waste, when casting, 50 lbs., which is the rule by which Lord Rosse estimates the weight of metal he requires. This alloy is nearly as hard as steel, and yet is almost as brittle as sealing-wax. Of this most unpromising material Lord Rosse has cast, ground, and has ready for polishing, a circular mass 6 feet in diameter, 5¾ inches thick, and weighing upwards of three tons, with a surface perfectly free from crack, or flaw, and quite homogeneous. The next head is

Casting.—On the first castings having flown into pieces, finding that the fragments no longer fitted each other in their former places, he perceived that they had been in a state of violent strain, arising from the cooling and setting of the outer parts, while the inner parts, yet fluid, were also largely expanded by the heat; this, and the porous surface, led him, by many stages and trials, to the remedy, which is simple and complete. The bottom of the mould is made of a ring of bar iron, packed full of slips of iron hoops set on their edges, which lie in parallel chords of the ring. These, though packed very tightly together, and so closely fitting that the melted metal cannot run between them, yet allow any air that is carried down to the bottom of the mould when the metal is cast in, to pass out through the interstices. After the ring is packed, it is secured in a lathe, and the face, which is to be the bottom of the mould, turned true to the convex shape to fit the concave speculum required. It is then placed flat on the ground by spirit levels, between the furnace in which the metal is melted, and the annealing oven, and the mould completed at the side with sand, in the way practiced by founders, but left open at top. The metal is then melted in cast-iron crucibles; wrought-iron would

be corroded by the speculum metal, and injure its properties, while fire clay crucibles will not answer. Unless the crucibles be cast with their bottoms downward, they will be porous, and the melted alloy will run through their fine pores. When the metal is melted, and still much too hot to pour, the crucibles are brought by a crane, and set firmly, each in a strong hoop iron cradle, which turns on gudgeons, and so arranged round the mould, that when the handles of the cradles are depressed, they pour out their molten mass direct into the mould. An oxide forms rapidly on the surface of the metal while too hot—this is as rapidly reduced back to the metallic state by constantly stirring it with a pine rod; as the temperature sinks the instant this reduction of the oxide begins to cease, is seized on as the proper moment for pouring. The liquid mass descends with a few fiery splashes, and after waving back and forward for a few seconds, the surface becomes still. The setting process begins at the hoop-iron bottom, where a thin film first sets—the process extends upwards in horizontal layers, and at length the top, though red, becomes fixed in form; the mass is then as tough as melting glass, and being turned out of the mould upon a proper truck, with the face upwards, is drawn into the oven to undergo the process of

Annealing, or very slow cooling. Here it is built up into the oven previously heated red hot, and fire is kept up under the floor of the oven for some days; the under fire places are then stopped, and all left for weeks to cool down to the temperature of the air. The six feet speculum was left here sixteen weeks. Here the particles of the alloy slowly arrange themselves into the arrangement in which the aggregating forces are in equilibrium, or natural and equal antagonist tension. When the oven is opened, the speculum is removed to the workshop, to undergo the process of

Grinding, which process was illustrated by working a model. In the workshop it is placed on a circular table, in a cistern filled with water, of temperature, say 55° Fahrenheit, with the face to be ground upwards. The circular table is turned round by the motion of the grinding engine. But first, the edge is made truly cylindrical by being surrounded by many pieces of deal board set in an iron ring pressing against the edge; emery being introduced as it turns round, soon grinds it cylindrical; it is then placed in the box in which it is to be used; here it is firmly secured by a ring of iron brought to embrace, firmly yet gently, its now truly cylindrical edge. The box and speculum, with the face to be ground placed upwards, is now again placed on the circular table in the cistern of water. Emery and water being placed upon it, the grinding disk is laid on, which is a cast-iron plate turned at one surface to the shape to fit the speculum when ground, grooved on that surface with many annular grooves concentric with the plate, and with many straight grooves running across it at right angles to each other. The back of this grinding plate is ribbed with six, or eight, radial ribs, to give it stiffness. This plate sits rather loosely in a ring of iron a little larger in diameter, which is driven back and forward by the motion of the steam engine. This ring has two motions, longitudinal and transverse. The engine causes it to

make 24½ strokes, for one turn of the speculum on its axis under the grinding disk, about 80 strokes taking place in a minute; the length of this stroke is one-third of the diameter of the speculum. The motion is produced by an eccentric pin. The transverse stroke takes place 1.72 times for each turn of the speculum, and its extent is, at the centre of the speculum, $\frac{27}{100}$ of the diameter of the speculum; it is produced by an eccentric fork. A fourth motion takes place by the grinding disk, while, for an instant, free of the ring, at the turn of the eccentrics, being carried round a little by the speculum, on which it is then lying, as it were, free; this causes it to turn once for about 15 turns of the speculum. Emery and water being constantly supplied, the surfaces of the grinding disk and speculum, in a few hours, grind each other truly spherical, whatever be their original defects of form. The process is finished, when, upon drawing off the grinding disk with one steady long pull, the surface of the speculum is left every where uniformly covered with the fine emery arranged in uniform lines, parallel to the line in which the disk was drawn off. A slight polish being now given to the speculum, its focal length is tested by a very simple process. The floors of the loft above the workshop, in the tower of the castle, contain trap-doors, which are now opened, and a mast erected on the top of the tower, which carries at its top a short cross-arm, to the under surface of which a watch dial is fastened, the face of the dial looking down on the speculum, now directly under it, and at a distance of 97 feet. A temporary eye-piece erected in the upper floor of the tower, soon finds the place of the faint and still imperfect image of the watch dial, the proper place of which is a matter of simple calculation, if the speculum be ground to the expected focus. If it be found incorrect, the grinding disk is rendered a little more flat, or a little more convex, and the grinding process is renewed, and so on, until the spherical face of the speculum is given its proper length of radius. When this is accomplished, the brilliant reflecting surface, and true form for producing a good image, is given to the speculum by the final process of

Polishing.—In this, two matters require attention, the polishing powder, and the surface of the polisher. The powder used by Lord Rosse, is not putty, or oxide of tin, as used by Newton and his followers, but red oxide of iron, procured by precipitation from green vitriol, or sulphate of iron, by water of ammonia; this is to be heated carefully in an iron crucible, for it has a tendency to take fire, and thus run many particles into one, and render the polishing powder too coarse. The surface of the polisher used by Newton, was pitch in a very thin layer. Instead of pitch, which Lord Rosse found too full of gritty impurities, he uses rosin tempered with spirit of turpentine. A large quantity of rosin being melted, the spirit of turpentine is poured in, and well mixed and incorporated (about a fifth by weight suffices.) The proper temper is known by taking up a little on an iron rod, and putting it into the water until it acquires the temperature, say of 55° Fahrenheit. Then if the thumb nail make a slight but decided impression, it is rightly tempered; if not, more rosin, or more spirit of turpentine, is added, until the proper temper is attained. The tem-

pered rosin is now divided into two parcels: to the one parcel a fourth part (by weight) of wheaten flour is added to give it tenacity, and diminish its adhesiveness. This is incorporated by stirring, until it becomes clear. To the other parcel an equal weight of rosin is added, which makes it very hard. Upon this, when cooled to 55°, the nail will scarcely make an impression. The grinding disk, with its spherical surface turned upwards, is now heated by fire underneath, and the rosin rendered tenacious by flour laid on with a brush in a thin even coat, at about 150° Fahr. This coat and the grinding disk are then allowed to cool down to about 100° Fahrenheit, when a thin coat of hard tempered rosin is laid on as evenly and thin as possible. The smooth, ground, concave speculum is now covered with a creamy coat of the fine polishing powder and water, and the warm polishing surface turned down upon it at about 80° Fahrenheit, when it soon takes the form of the speculum as in a mould; care must be taken not to put on the polishing plate too hot for fear of cracking the speculum, which the interposed creamy polishing powder helps to protect; nor too cold, else it will not take the proper figure. The grinding engine now gives the same motions to the polishing plate as before, but its weight is much diminished by counterpoising it. The soft tenacious coat below, and the grooves on the surface of the grinding disk, permit the proper lateral expansion, while the hard outer coating retains its form, and holds firmly embedded the particles of polishing powder. The polishing now proceeds rapidly, and as soon as what is technically called the black polish is attained, the defining power is judged of by examining the minute divisions of the image of the watch dial, under an eye-piece of high power. The true form is known to be given as the polishing proceeds, if the focal length slowly increases in a tabulated proportion to the time. The six foot speculum it is expected will be finished after six hours' polishing.

Civ. Eng. & Arch. Journ.

Messrs. Young and Delcambre's Type-Setting Machine. By the Secretary *of the Society of Arts, &c.*

It may be well to give a short explanation of the ordinary mode of setting up type, before describing the mechanical contrivance for the same purpose, by Messrs. Young and Delcambre.

The various letters and figures to be used in any composition, are arranged in trays technically called cases. These cases have small compartments, or boxes, differing in size according to the recurrence of the letters; thus e, the letter most used, requires the largest compartment. The boxes next in size are for the letters c, d, i, m, r, t, and u, and so on. The type-case stands upon a sloping frame of sufficient elevation for a man of ordinary height to pick out the letters, or types, from the various boxes. This person is called a compositor, and holds in his left hand what is called a composing stick. In this composing-stick, or metal trough, (the length of which is adjustable to serve for lines of every length,) he places the letters, and the vari-

ous spaces, quadrats, &c., which separate the words. It must be borne in mind that the same person who composes the type also justifies the page, that is, leaves it in a fit state to go into the printing-press, by adjusting each line to the exact length required for the width of the page on which he is engaged.

When the composing-stick is filled with eight or twelve lines of type, the mass is removed to, and placed upon a galley, or long tray, and the compositor again sets about refilling his stick. Of course, to make up a sheet it requires a number of pages, the arrangement of which is called imposing. But it is not here required to explain the operations of the printing office further.

The upper part of Messrs. Young and Delcambre's machine consists of the type-reservoirs, or grooves, each of which is $\frac{3}{16}$ths of an inch in width, and of a depth equal to the length of the type, or nearly one inch.

These reservoirs are placed in a slightly inclined position, to prevent the letters from falling out, the longest reservoirs in use correspond with the largest compartments of the ordinary compositor's case already noticed.

Immediately below the reservoirs are as many levers, or cutters, the use of which is to cut off, or displace laterally, the bottom letter of each column of type. The cutters are worked by vertical steel rods, which are connected with the keys in front of the machine, and which latter are similar in appearance to the keys of a piano-forte.

The movement to effect the displacement of the types is one of the most beautiful contrivances in the whole apparatus. By pressing on any one of the keys, its vertical rod is drawn down, and the button at the top of the rod is pressed against the side of the contiguous lever, or cutter, which is moved laterally and horizontally on a pivot; and the lever pressing against the lowest letter of the superincumbent column of type, pushes it through a lateral aperture, just as wide as the thickness of one type, which, thus liberated, is placed at the top of an inclined plate, extending throughout the width of the machine at the back, and runs down a curvilinear track, or groove, to take its place next to the type previously sent down.

The inclined plate is constructed of brass, and contains several tracks, or channels, down which the letters glide at intervals, regulated by the manipulation of the performer. The first curvilinear channel to the right hand serves for the letters a and b, the second for c and d, and so on, as the letter a is pushed towards the right hand, and b towards the left, so as to make each channel serve for two kinds. The forty-eight channels, therefore, serve for ninety-six kinds of type, and all the channels lead into each other in a serpentine manner, somewhat as in railway tracks, or the tracery of Gothic architecture, so as to converge into one single outlet at the bottom of the incline. These curvilinear channels are of equal length from the many points of delivery at the top of the incline, to the one single point of discharge at the bottom of the same, so that the types descend in equal times, and in the exact order in which the piano-forte keys are depressed.

At the point of discharge is an eccentric movement, worked by a treadle, to regulate the admission of the stream of type into a long open trough, or channel, leading to the composing-stick, which is situated, as it were, at the end of the galley containing the column of the composed matter. The assistant slides so much of the long stream of type into the composing-stick as will well form one line; the requisite spaces are then adjusted to make the line of the exact length, and, by a lever movement, the bottom of the composing-stick is withdrawn, which deposits the line of type on those previously set up in the galley; and lastly, the long column of type, as that of a newspaper, is made up into pages as usual.

In this apparatus there are altogether ninety-six keys, of which seventy-two correspond with small Roman letters, figures, stops, &c., and the remaining twenty-four with the small-caps, or capitals, which have reservoirs apart from the rest, and which are placed in the back of the machine.

When in full work as many as 8000 letters, &c., have been set up by this machine in an hour, whereas, by the ordinary mode, a good compositor can, on the average, only set up about 1700 letters in the same time; the wages paid in each case being nearly the same amount. Trans. Soc. Arts, &c.

On Simms' Self-Acting Circular Dividing Engine.

At a recent meeting of the Astronomical Society, Mr. W. Simms read a description of his Self-Acting Circular Dividing Engine. In its general arrangement and construction, it is very similar to that made by Mr. E. Troughton, though there are several additions and peculiarities, which are pointed out. The circle, or engine plate, is of gun metal, forty-six inches in diameter, and was cast in one entire piece, teeth being ratched upon its edge. The centre of the engine plate is so arranged that it can be entered by the axis of the instrument to be divided, and the work, by this means, brought down to bear upon the surface of the engine plate, which arrangement prevents the necessity of separating the part intended to receive the divisions from its axis, &c., a process both troublesome and dangerous. Upon the surface, and not far from the edge of the engine plate, are two sets of divisions to spaces of five minutes, one set being in silver, and the other strongly cut upon the gun metal face. There are also as many teeth upon the edge as there are divisions upon the face of the engine plate, namely, 4,320, and, consequently, one revolution of the endless screw moves through a space of five minutes. The silver ring was divided according to Troughton's method, with some slight variations. In this operation it seemed to the author the safer course to divide the circle completely, and then to use a single cutter for ratching the edge; and he believes that the teeth upon the edge have been cut as truly as the original divisions themselves. Another important arrangement is, that the engine is self-acting, and requires no personal exertion, or superintendence, nothing being necessary but

the winding up of the machine, or rather the raising of a weight, which, by its descent, communicates motion to the dividing engine. The machinery is so arranged that it can be used, or dispensed with, at pleasure, there being some cases in which a superintending hand is desirable. The author then proceeds with a description of the machinery, as represented in the drawings accompanying this paper; and draws attention to the contrivance by which the engine can discharge itself from action when it has completed its work. He concluded by observing, that the machinery is simple, by no means expensive, can be made by an ordinary workman, is adapted to all the engines now in existence, which are moved by an endless screw, lessens the labor of the artist, and increases the accuracy of the graduated instrument. **Glasgow Mech. & Eng. Mag.**

Efficiency of Iron Vessels.

As a proof of the efficiency of iron vessels, we have received the following testimony, in a letter from Captain Beckett, commander of the iron steam ship Troubadour, dated Liverpool, 22d Sept., 1843; addressed to Messrs. Thomas Vernon & Co., iron ship builders, Barrack street, Liverpool.

"*Gentlemen,*—In reply to your inquiry respecting the iron steam ship Troubadour, which was built by you about two years ago, I beg to state, that having had the command of her ever since she started running regularly between this port and Bristol, I have paid particular attention to her capabilities as regards sailing, strength, and carrying of cargo, and have great pleasure in stating that she is a most excellent sea-boat, and of surprising speed considering the power of her engines.

"I have frequently had on board of her upwards of 300 tons dead weight of cargo, and take the ground on every trip at Swansea, yet I cannot find out the least appearance of straining. I have not, in a single instance, had any occasion to use the pumps, the vessel not having made one drop of water, though often severely tried in the roughest weather. I have lately had her in the graving dock, when I examined her bottom very minutely, and was astonished to find her perfect in every part, not the slightest appearance of corrosion any where, and every plate, rivet, and fastening, as good as the first day she left your hands. I remain, gentlemen, yours truly,

JAMES BECKETT."

Ibid.

Longest Wire Rope.

The longest wire rope in the world, has just been completed at the Patent Wire Rope Works of R. S. Newall & Co., Gateshead. It measures 6,000 yards in length, in *one piece*, without splice, and is longer, by 1000 yards, than any rope hitherto made. It is for the Durham and Sunderland Railway Company, who have at work, on *one engine*, 15,000 yards of Newall & Co's. wire rope; it is in *one*

length, but contains two splices. We understand that this particular kind of wire rope is now almost entirely used on the Blackwall Railway, and that in consequence there has not been a breakage during the last three months; whereas, formerly there were two or three breakages a day. Civ. Eng. & Arch. Journ.

Lunar Occultations.

Lunar Occultations visible in Philadelphia during the month of May, 1844; computed by Mrs. Charlotte S. Downes, from the Elements published with the Occultation list of the United States Almanac.

The Immersions and Emersions are for Philadelphia, mean astronomical time. Im. for Immersion, Em. for Emersion. These abbreviations in *Italics* refer to those Immersions and Emersions which take place on the Moon's dark limb. N. App. for Near Approach.

The angles are for *inverted image*, or as seen in an astronomical telescope, and reckoned from the Moon's North point and from its Vertex around through East, South, West, to North and Vertex again. For direct vision add 180°.

MAY, 1844.

Day.	H'r.	Min.	Star's name.	Mag.	From North.	From Vertex.
3	10	55	Im. *g* Ophiuchi,	5	148°	171°
	11	45	*Em.*		236	249
7	14	20	Im. τ^1 Capricorni,	6	51	93
	15	35	*Em.*		268	299
7	15	53	Im. τ^2 Capricorni,	6	59	80
	17	16	*Em.*		253	254
19	6	48	*Im.* Bessel,	9	47	352
	7	24	Em.		337	283
19	7	22	N. App. Bessel ☽ N. 3′,	9		
20	7	59	*Im.* Bessel,	8.9	105	51
	8	58	Em.		287	264
20	8	37	*Im.* Bessel,	9	87	34
	9	29	Em.		304	235
20	9	6	*Im.* Bessel,	9	87	36
	9	56	Em.		304	257
20	9	48	*Im.* Bessel,	9	139	91
	10	29	Em.		249	204
20	9	40	*Im.* Bessel,	9	85	36
	10	34	Em.		302	258
21	6	46	*Im.* *f* Geminorum,	5.6	102	50
	7	54	Em		305	251
21	7	9	*Im.* Bessel,	9	159	106
	7	56	Em.		245	192
21	7	54	*Im.* Bessel,	9	130	76
	8	53	Em.		278	224
21	8	35	*Im.* Bessel,	9	86	32
	9	29	Em.		315	262
21	9	33	*Im.* Bessel,	9	71	19
	10	17	Em.		327	277
21	9	48	N. App. Bessel, ☽ S. 2′,	9		
21	9	44	*Im.* Bessel,	8	146	95
	10	28	Em.		251	201
22	6	12	*Im.* 29 Cancri,	6	146	106
	7	20	Em.		268	221
24	9	37	*Im.* 19 Sextantis,	7	138	92
	10	39	Em.		278	229
30	14	8	*Im.* δ Scorpii,	3	69	33
	15	9	Em.		301	261